Instruction Manual

MODEL 845AR

HIGH IMPEDANCE VOLTMETER
NULL DETECTOR

FLUKE®

JOHN FLUKE mfg. co., inc.
SEATTLE, WASHINGTON

JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

© Copyright, John Fluke Mfg. Co., Inc.
April, 1968

MODEL 845AR

HIGH IMPEDANCE VOLTMETER-NULL DETECTOR

warranty

The JOHN FLUKE MFG. CO., INC.* warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. Notify the John Fluke Mfg. Co., Inc.,* giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forewarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

All shipments of John Fluke Mfg. Co., Inc.* instruments should be made via **Railway Express**** prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc.* Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc.* will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P.O. BOX 7428, SEATTLE, WASHINGTON 98133.*

*For European customers: FLUKE (Nederland) N.V.
Ledeboerstraat 27, P.O. Box5053
Tilburg, The Netherlands

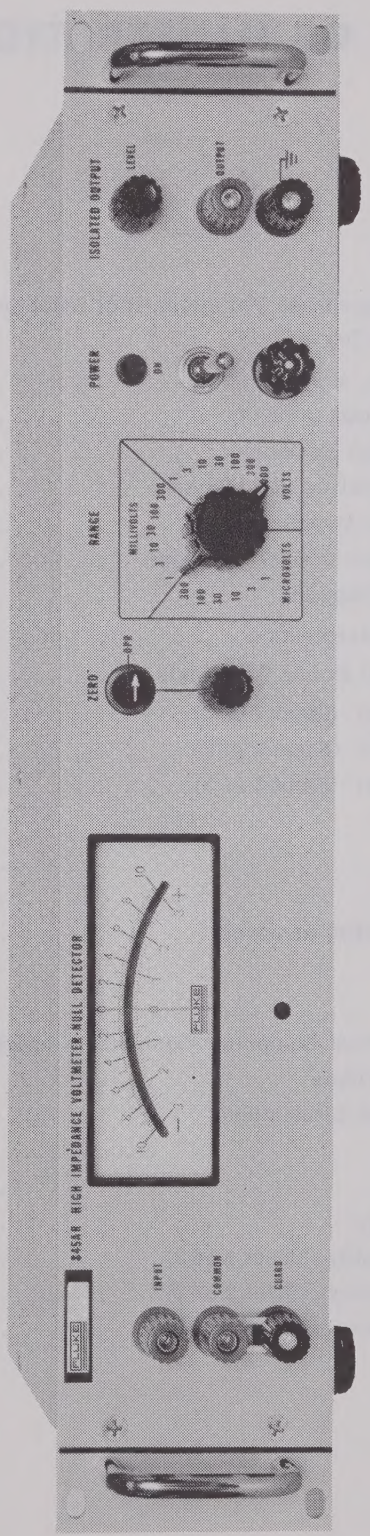
**For European customers Air Freight prepaid.

TABLE OF CONTENTS

Section	Title	Page
I	INTRODUCTION AND SPECIFICATIONS	1-1
	1-1. Introduction	1-1
	1-4. Electrical Specifications	1-1
	1-5. Environmental Specifications	1-1
	1-6. Mechanical Specification	1-2
II	OPERATING INSTRUCTIONS	2-1
	2-1. Receiving Inspection	2-1
	2-3. Controls, Terminals, and Indicator	2-1
	2-5. Preliminary Operation	2-1
	2-7. Mechanical Zeroing	2-2
	2-9. Operation as a High Impedance Voltmeter	2-2
	2-11. Operation as a Null Detector	2-2
	2-13. Measuring Voltages With a Standard Cell	2-3
	2-15. Use of Isolated Output	2-3
	2-20. Operating Notes	2-3
III	THEORY OF OPERATION	3-1
	3-1. Introduction	3-1
	3-3. Block Diagram Analysis	3-1
	3-8. Circuit Description	3-2
IV	MAINTENANCE	4-1
	4-1. General	4-1
	4-3. Test Equipment	4-1
	4-5. 230 Volt Power-Line Conversion	4-1
	4-8. Disassembly Instructions	4-1
	4-10. Corrective Maintenance	4-2
	4-20. Calibration Procedures	4-5
V	LIST OF REPLACEABLE PARTS	5-1
	5-1. Introduction	5-1
	5-3. Columnar Information	5-1
	5-4. How to Obtain Parts	5-1
	5-7. List of Abbreviations	5-2
	5-8. Serial Number Effectivity	5-12
	APPENDIX A	
	JOHN FLUKE MFG. CO. WARRANTY	
	LIST OF SALES REPRESENTATIVES	
	SCHEMATIC DIAGRAM	

LIST OF ILLUSTRATIONS

Figure	Title	Page
Frontispiece	Model 845AR High Impedance Voltmeter-Null Detector	iii
1-1.	Model 845AR Outline Drawing	1-2
2-1.	Controls, Terminals, and Indicator	2-1
2-2.	Bridge Detector - Floating Supply	2-2
2-3.	Bridge Detector - High Resistance	2-2
2-4.	Bridge Detector - Floating Null Detector	2-3
2-5.	Standard Cell Voltage Measurements	2-3
2-6.	Chassis Ground - Jumper Wire Location	2-4
3-1.	Model 845AR Block Diagram	3-1
4-1.	Test Equipment Requirements	4-1
4-2.	T201 115/230 Volt AC Power Terminals	4-2
4-3.	Troubleshooting Chart (Sheet 1 of 3)	4-2
4-3.	Troubleshooting Chart (Sheet 2 of 3)	4-3
4-3.	Troubleshooting Chart (Sheet 3 of 3)	4-4
4-4.	Waveform at TP10	4-4
4-5.	Waveforms at TP6	4-4
4-6.	Waveform at TP7	4-5
4-7.	Waveform at TP7 - Q104 Removed	4-5
4-8.	Waveform at TP2	4-5
4-9.	Waveform at TP1	4-5
4-10.	Leakage Resistance Test Equipment Equipment Connections	4-6
4-11.	Test and Alignment Points	4-6
4-12.	Calibration Equipment Connections	4-6
5-1.	Final Assembly	5-3
5-2.	Chassis Assembly	5-4
5-3.	Front Panel Assembly	5-5
5-4.	Amplifier P/C Assembly (Sheet 1 of 2)	5-7
5-4.	Amplifier P/C Assembly (Sheet 2 of 2)	5-8
5-5.	Power Supply P/C Assembly	5-10



MODEL 845AR HIGH IMPEDANCE VOLTMETER-NULL DETECTOR

SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. The Fluke Model 845AR High Impedance Voltmeter-Null Detector allows measurement of dc voltages from one microvolt to 1000 volts dc in 19 ranges. When used as a null detector on the 100 millivolt range and below, the input impedance is an excellent 10 megohms. A linear recorder output allows the instrument to be used for production testing, and also as a dc amplifier with a maximum gain of 120 db.

1-3. The instrument may be wired to operate from a line power source of 115 volts ac or 230 volts ac, as desired. The instrument is designed to be mounted directly in a standard EIA 19 inch relay rack. Resilient feet are also provided for bench top use.

1-4. ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE RANGE
1 microvolt to 1000 volts dc end scale in nineteen ranges, using X1 and X3 progression.

INPUT RESISTANCE
100 megohms on 300 millivolt range and above; 10 megohms on 100 millivolt range and below.

ACCURACY
±(3% end scale + 0.1 microvolt).

MAXIMUM NOISE (input shorted)

Range	Noise (peak-peak)
1 microvolt	0.20 microvolt
3 microvolt	0.25 microvolt
10 microvolt - 1000 volt	0.30 microvolt

METER RESPONSE TIME (to 90% of reading)

Range	Time
1 microvolt	5 seconds
3 microvolt	3 seconds
10 microvolt - 1000 volt	1-1/2 seconds

INPUT ISOLATION
Better than 10^{12} ohms at less than 50% relative humidity and 25° C regardless of line, chassis, or recorder grounding. Better than 10^{10} ohms up to 80% relative humidity and 35° C. With driven guard, isolation improves by at least one order of magnitude up to 10^{13} ohms. Any input terminal may be floated 1100 volts off chassis ground.

DC COMMON MODE REJECTION
Better than 160 db, input short-circuited, 80% relative humidity; better than 140 db, open-circuited, 50% relative humidity; better than 120 db, open-circuited, 80% relative humidity.

AC COMMON MODE REJECTION (below 100 kHz)
100 volts rms or 120 db greater than end scale, whichever is less, will effect reading less than 2% of end scale. Input open-circuited.

AC NORMAL MODE REJECTION (60 Hz and above)
AC voltages 60 db above end scale will effect reading less than 2% of end scale. Maximum voltage not to exceed 750 volts rms.

RECORDER OUTPUT
0-1 volt, one side at chassis ground; linear to 0.5% of end scale. Source impedance, 5k to 7.5k.

STABILITY OF ZERO
Better than 0.15 microvolt/hr, better than 0.3 microvolt/day.

TEMPERATURE COEFFICIENT OF ZERO
Less than 0.1 microvolt/° C from 15° C to 35° C. Less than 0.2 microvolt/° C from 0° C to 50° C.

ZERO CONTROL RANGE
±5 microvolt minimum.

OVERLOAD PROTECTION
Up to 1100 volts dc may be applied on any range. Typical recovery time is 4 seconds.

INPUT POWER
115/230 volts ac ±10%, 50 to 440 Hz, approximately 3 watts.

1-5. ENVIRONMENTAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE
Within all specifications from 15° C to 35° C.

Within all specifications from 0° to 50° C except:
Derate by a factor of two —
Maximum Noise and Meter Response Time.
DC Common Mode Rejection —
Derate by 20 db.

STORAGE TEMPERATURE RANGE
-40° C to +70° C.

RELATIVE HUMIDITY RANGE
0 to 80%.

SHOCK
Meets hammer blow requirements of MIL-T-945A and MIL-S-901B.

VIBRATION
Meets 10 Hz to 55 Hz tests of MIL-T-945A.

1-6. MECHANICAL SPECIFICATIONS

MOUNTING
Standard EIA relay rack. Resilient feet provided for bench use.

WEIGHT
9 pounds.

SIZE
3.47 inches high x 19 inches wide x 8.26 inches deep.

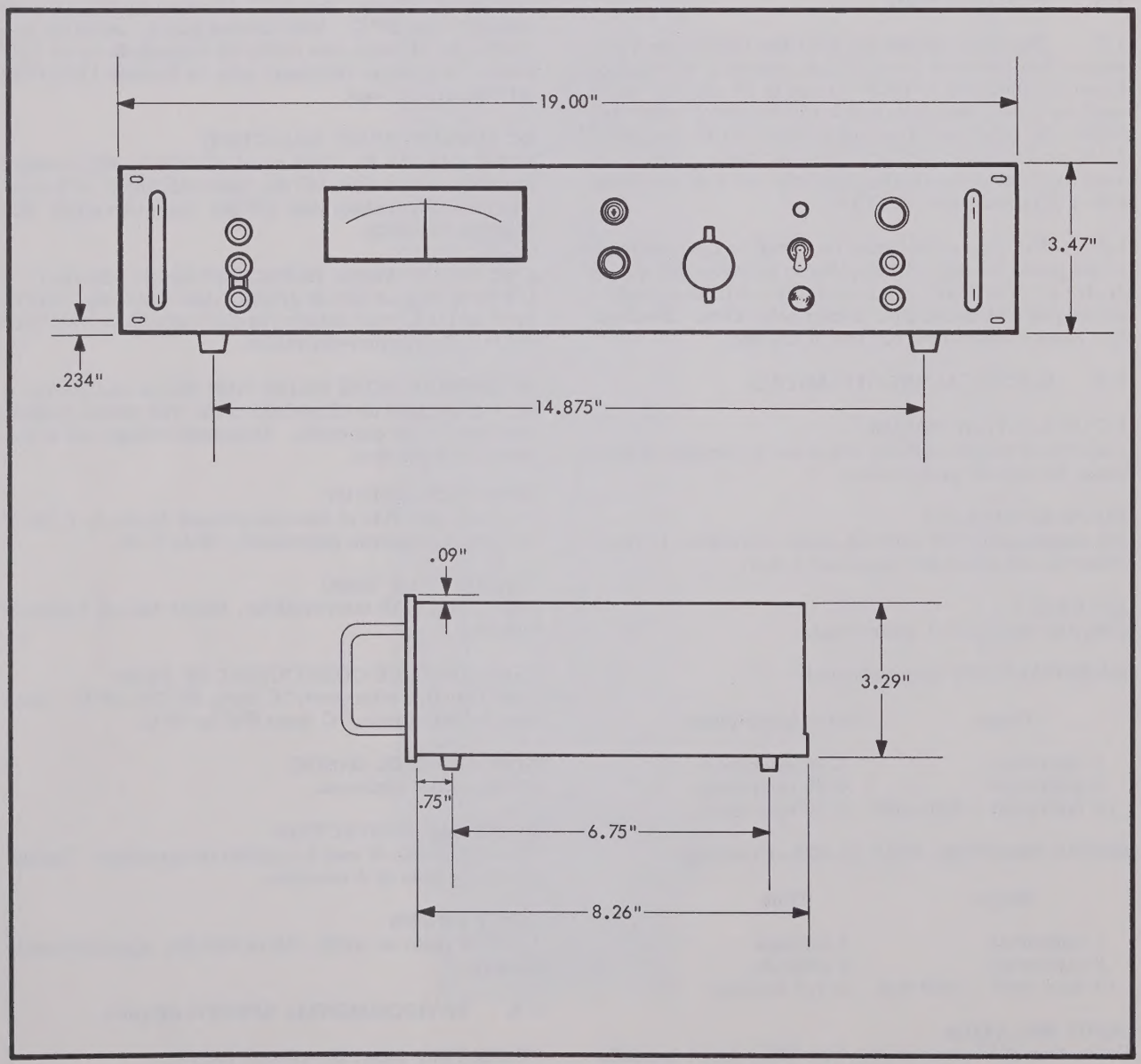


Figure 1-1. MODEL 845AR OUTLINE DRAWING

SECTION II

OPERATING INSTRUCTIONS

2-1. RECEIVING INSPECTION

2-2. This instrument has been thoroughly tested and inspected before being shipped from the factory. Immediately upon receiving the instrument, carefully inspect for damage which may have occurred during shipment. If any damage is noted, follow the instructions outlined in the warranty page at the back of this manual.

2-3. CONTROLS, TERMINALS, AND INDICATOR

2-4. The location and function of the front-panel controls are described in Figure 2-1. Detailed operating descriptions are given in the following paragraphs.

2-5. PRELIMINARY OPERATION

2-6. Connect the Model 845AR line plug to a 115 volt ac power outlet or to 230 volts ac if the instrument is so wired.

WARNING!

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead from the adapter to a high-quality earth ground.

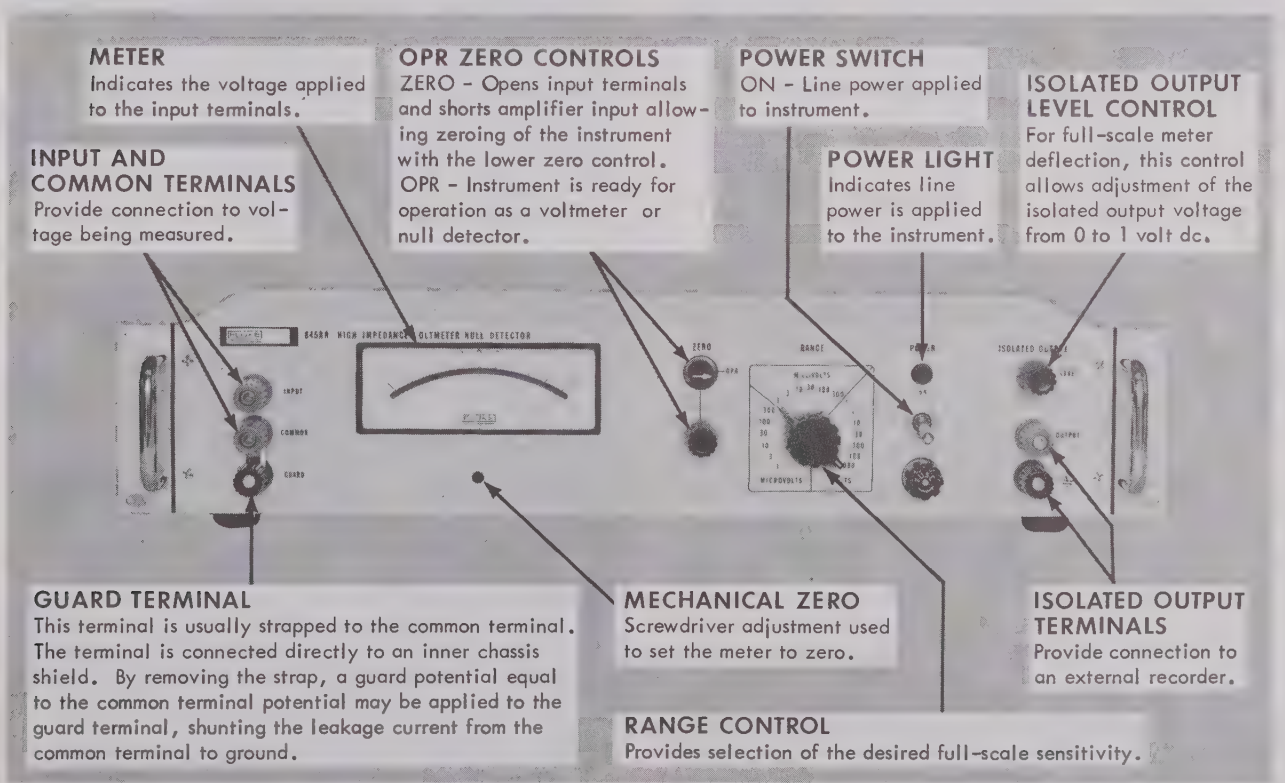

METER
Indicates the voltage applied to the input terminals.
OPR ZERO CONTROLS
ZERO - Opens input terminals and shorts amplifier input allowing zeroing of the instrument with the lower zero control.
OPR - Instrument is ready for operation as a voltmeter or null detector.
POWER SWITCH
ON - Line power applied to instrument.
ISOLATED OUTPUT LEVEL CONTROL
For full-scale meter deflection, this control allows adjustment of the isolated output voltage from 0 to 1 volt dc.
INPUT AND COMMON TERMINALS
Provide connection to voltage being measured.
POWER LIGHT
Indicates line power is applied to the instrument.
GUARD TERMINAL
This terminal is usually strapped to the common terminal. The terminal is connected directly to an inner chassis shield. By removing the strap, a guard potential equal to the common terminal potential may be applied to the guard terminal, shunting the leakage current from the common terminal to ground.
MECHANICAL ZERO
Screwdriver adjustment used to set the meter to zero.
ISOLATED OUTPUT TERMINALS
Provide connection to an external recorder.
RANGE CONTROL
Provides selection of the desired full-scale sensitivity.

Figure 2-1. CONTROLS, TERMINALS, AND INDICATOR

a. Place the Model 845AR controls as follows:

POWER	ON
RANGE	10 MICROVOLTS
OPR/ZERO	ZERO

b. Adjust the zero control for an initial zero meter deflection. Place the RANGE switch to the 1 MICROVOLT RANGE and re-zero with the zero control.

2-7. MECHANICAL ZEROING

2-8. It may become necessary to adjust the mechanical zero control of the Model 845AR at more frequent intervals than complete calibration. To mechanically zero the instrument proceed as follows:

a. Place the RANGE switch to 1000 VOLTS and the POWER switch to ON.

b. Adjust the mechanical zero adjustment screw for zero meter deflection.

c. Place the RANGE switch to 10 MICROVOLTS and electrically zero the instrument as outlined in paragraph 2-5.

d. Repeat steps a and b.

2-9. OPERATION AS A HIGH IMPEDANCE VOLTMETER

2-10. To operate the Model 845AR as a High Impedance Voltmeter perform the preliminary operations according to paragraph 2-5 and proceed as follows:

a. Place the controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	1000 VOLTS

Note!

When measuring voltages in the microvolt ranges, use copper wire having low thermal EMF's.

b. Connect the voltage to be measured to the Model 845AR INPUT terminal and connect the common point of the voltage being measured to the COMMON terminal.

c. Deflection of the meter indicates the polarity and magnitude of the measured voltage. Increase the sensitivity of the Model 845AR for maximum on-scale deflection.

2-11. OPERATION AS A NULL DETECTOR

2-12. The Model 845AR may be used to monitor small voltage differences in bridge circuits, potentiometers, and other measuring apparatus. In most of these applications the circuits are adjusted for zero deflection or a null on the Model 845AR. Equipment connections for various types of null detector configurations are illustrated by Figure 2-2 through 2-4. To operate the Model 845AR as a Null Detector, perform the preliminary operations according to paragraph 2-5 and proceed as follows:

a. Select the desired equipment application as illustrated by Figure 2-2 through 2-4 and make the appropriate equipment connections.

b. Place the Model 845AR controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	as desired

c. Adjust the circuit being measured for zero or a null deflection on the Model 845AR meter.

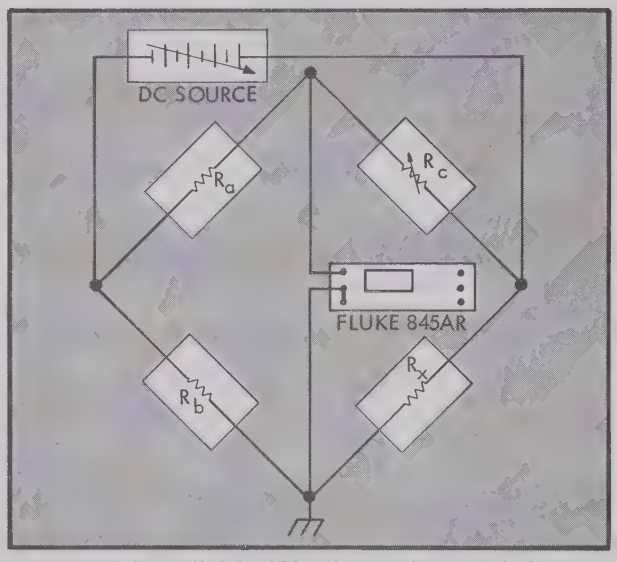


Figure 2-2. BRIDGE DETECTOR - FLOATING SUPPLY

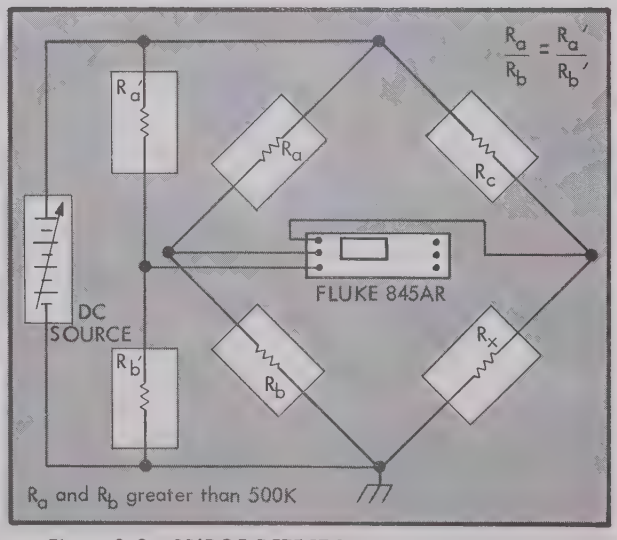


Figure 2-3. BRIDGE DETECTOR - HIGH RESISTANCE

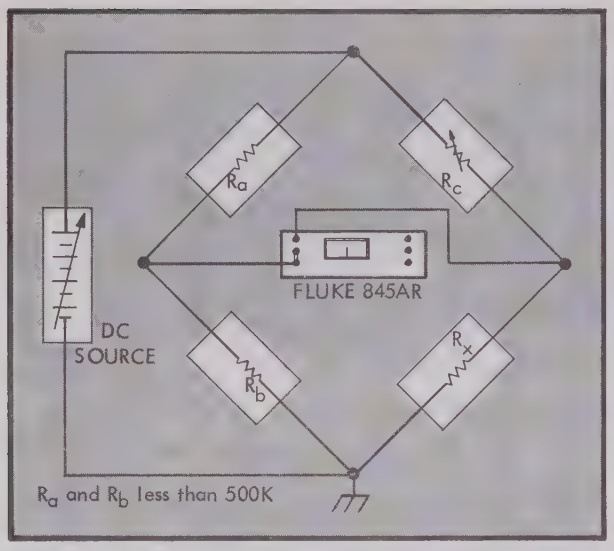


Figure 2-4. BRIDGE DETECTOR - FLOATING NULL DETECTOR

2-13. MEASURING VOLTAGES WITH A STANDARD CELL

2-14. The Model 845AR may be used with a voltage divider and a standard cell to calculate unknown voltages with a high degree of accuracy. Connect the equipment as illustrated in Figure 2-5. Perform the preliminary operation as outlined in paragraph 2-5 and proceed as follows:

a. Place the Model 845AR controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	as desired

b. Adjust the voltage divider for zero or null deflection on the Model 845AR meter while placing the RANGE switch to successively more sensitive ranges.

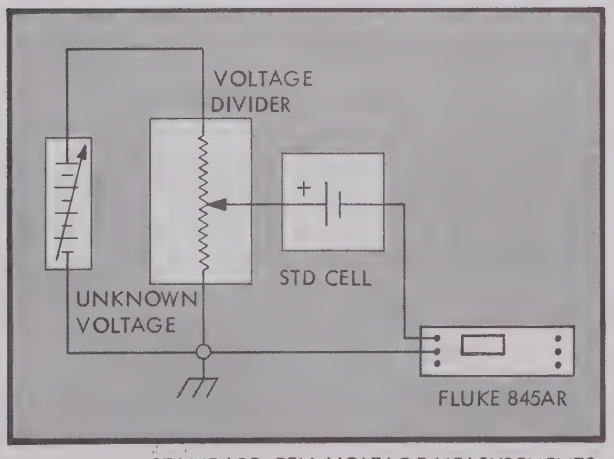


Figure 2-5. STANDARD CELL VOLTAGE MEASUREMENTS

c. Calculate the unknown voltage by dividing the standard cell voltage by the final division ratio of the divider.

2-15. USE OF ISOLATED OUTPUT

2-16. DC ISOLATION AMPLIFIER

2-17. The Model 845AR may be used as a dc isolation amplifier having a voltage gain of up to 120 db, depending on the settings of the RANGE switch and the OUTPUT LEVEL control. To compute the maximum voltage gain on any range of the Model 845AR, use the following formula:

$$\text{Voltage gain in db} = 20 \log_{10} \frac{\text{1 volt (maximum isolated output)}}{\text{Range (in volts)}}$$

2-18. RECORDER OUTPUT

2-19. The Model 845AR ISOLATED OUTPUT may be used to provide an output voltage, adjustable from zero to one volt for a full-scale meter deflection for use with a recorder. Since the output is isolated from the input, floating measurements can be made without the use of a floating recorder. To use the adjustable recorder output, proceed as follows:

a. Connect the recorder to the ISOLATED OUTPUT terminals.

Note!

The lower ISOLATED OUTPUT terminal is connected to chassis ground. If a ground reference is undesirable, remove the jumper wire above R202 on the power supply circuit board. Refer to Figure 2-6 for jumper wire location.

b. Turn the recorder on.

c. Proceed as outlined in paragraph 2-9 or 2-11, as desired.

d. Adjust the ISOLATED OUTPUT LEVEL control for the desired output to the recorder. This control has a log taper so that smooth control is possible at both high and low settings.

Note!

The ISOLATED OUTPUT current capability is 100 microamperes with a 5 kilohm source impedance.

2-20. OPERATING NOTES

2-21. SPURIOUS VOLTAGES AND CURRENTS

2-22. Voltage measurements at the microvolt level involve the persistant problems of thermoelectric effects. These effects may be compensated for by temporarily disconnecting the voltage from the circuit under measurement and noting the meter deflection of the

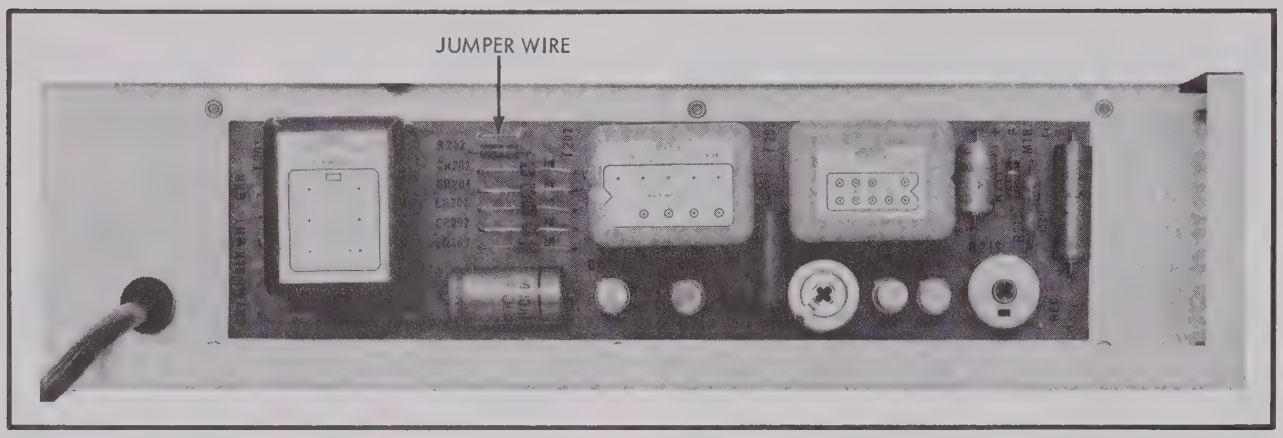


Figure 2-6. CHASSIS GROUND - JUMPER WIRE LOCATION

Model 845AR on the desired range. This reading must then be subtracted from all subsequent voltage measurements. A thorough understanding of these effects can lead to reducing or eliminating them completely.

2-23. THERMOELECTRIC VOLTAGES

2-24. If a circuit is composed of two dissimilar metals, a net voltage will result if the two dissimilar junctions are maintained at different temperatures. These thermoelectric voltages, also known as thermals, thermocouple voltages, or Seebeck voltages, can be reduced by using metals having low thermoelectric potentials, and keeping all junctions at the same temperature. The terminals of the Model 845AR are made of pure copper, gold-flashed to prevent tarnish. For lowest thermal voltages, all connections to the Model 845AR should be made with pure copper wire. Silver plated copper or solder coated copper also produce satisfactory results. Tinned copper is less satisfactory than silver plated or copper coated copper. Nickel and nickel-based alloys are not suitable for connections to the instrument. Excellent results can be obtained using ordinary TV twin lead, or even lamp cord if high insulation resistance is not required. If shielding is necessary, use a length of flat braid over the cable.

2-25. HIGH SOURCE IMPEDANCE

2-26. Due to the very high input resistance and extreme sensitivity of the Model 845AR, it is charge sensitive. Thus, a person's body potential, an electrostatic voltage, can cause charge redistribution at the input to the instrument and result in meter needle deflection as a hand approaches the input terminals. Careful shielding will eliminate this problem. Also, due to charges that may be deposited on the input terminals when the OPR-ZERO switch is set to ZERO, an appreciable transient will result when the switch is set to OPR if nothing is connected to the input terminals. Turning the switch back and forth will dissipate this charge, eliminating the problem. With a high source impedances, the response of the instrument is unavoidably slow due to the low pass filter used to suppress superimposed noise. However, the design of the low pass filter is such that common mode rejection is extremely high while the response time for the normally encountered low source impedances is very fast.

2-27. OVERLOAD VOLTAGES

2-28. The instrument is designed to withstand up to 1100 volts dc or 1100 volts peak ac continuously applied between any two of the three input terminals or between cabinet ground and any of the three input terminals regardless of the setting of the RANGE or OPR-ZERO switch. However, repeated or continuous overloads above 200 volts in the ranges below 3 millivolts will result in dissipation in protective, low-pass-filter resistor R110. This will result in thermal voltages which may take several minutes to subside after the overload is removed.

2-29. GUARDING

2-30. The instrument has an inner chassis connected to the GUARD terminal on the front panel. Ordinarily, this GUARD terminal is strapped to the COMMON terminal. When connected in this way the inner chassis serves as a shield. This greatly improves the leakage resistance to ground and the common mode rejection. However, since the inner chassis is available at the GUARD terminal, it may be driven at the same voltage as the COMMON terminal. This further increases the leakage resistance and common mode rejection by about ten times. The voltage used to drive the GUARD terminal should be obtained from a separate source or by means of a voltage divider connected directly across the source so that the leakage currents do not cause voltage drops across impedances in the circuit under measurement.

2-31. INCREASING INPUT RESISTANCE

2-32. In the 1 microvolt to 1 millivolt ranges, a 10 megohm resistor is connected directly across the input of the instrument. The input resistance may be increased on these ranges by disconnecting the 10 megohm resistor where it attaches to the RANGE switch. However, the input resistance will no longer be well defined. Typical input resistances with the 10 megohm resistor removed are as follows:

Range	Input Resistance
1 uv	300 megohms
3 uv	1,000 megohms
10 uv	3,000 megohms
30 uv to 1 mv	10,000 megohms

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. The Model 845AR High Impedance Voltmeter-Null Detector theory of operation is contained in this section of the manual. A block diagram is illustrated in Figure 3-1, and a functional schematic diagram is located at the end of Section V. The block diagram and functional schematic diagram are to be used as an aid in understanding circuit theory, and in troubleshooting.

3-3. BLOCK DIAGRAM ANALYSIS

3-4. The Model 845AR is a photo-chopper stabilized amplifier with the overall gain of the amplifier being precisely controlled by negative feedback. The instrument's main circuits are an input range divider, a photocell modulator, an ac amplifier, a synchronous demodulator, a dc amplifier, a meter, an isolation converter, a neon drive, an 84 Hz multivibrator, a supply rectifier, and a rectifier filter.

3-5. The input range divider provides a fixed input impedance to signals of less than 1 millivolt while allowing reduction of input signals above 1 millivolt. Photochoppers modulate the input signal to the ac amplifier at 84 Hz. The drive signal for the photo modulator is provided by the neon drive which is composed of neon lamps driven alternately at 84 Hz by the 84 Hz

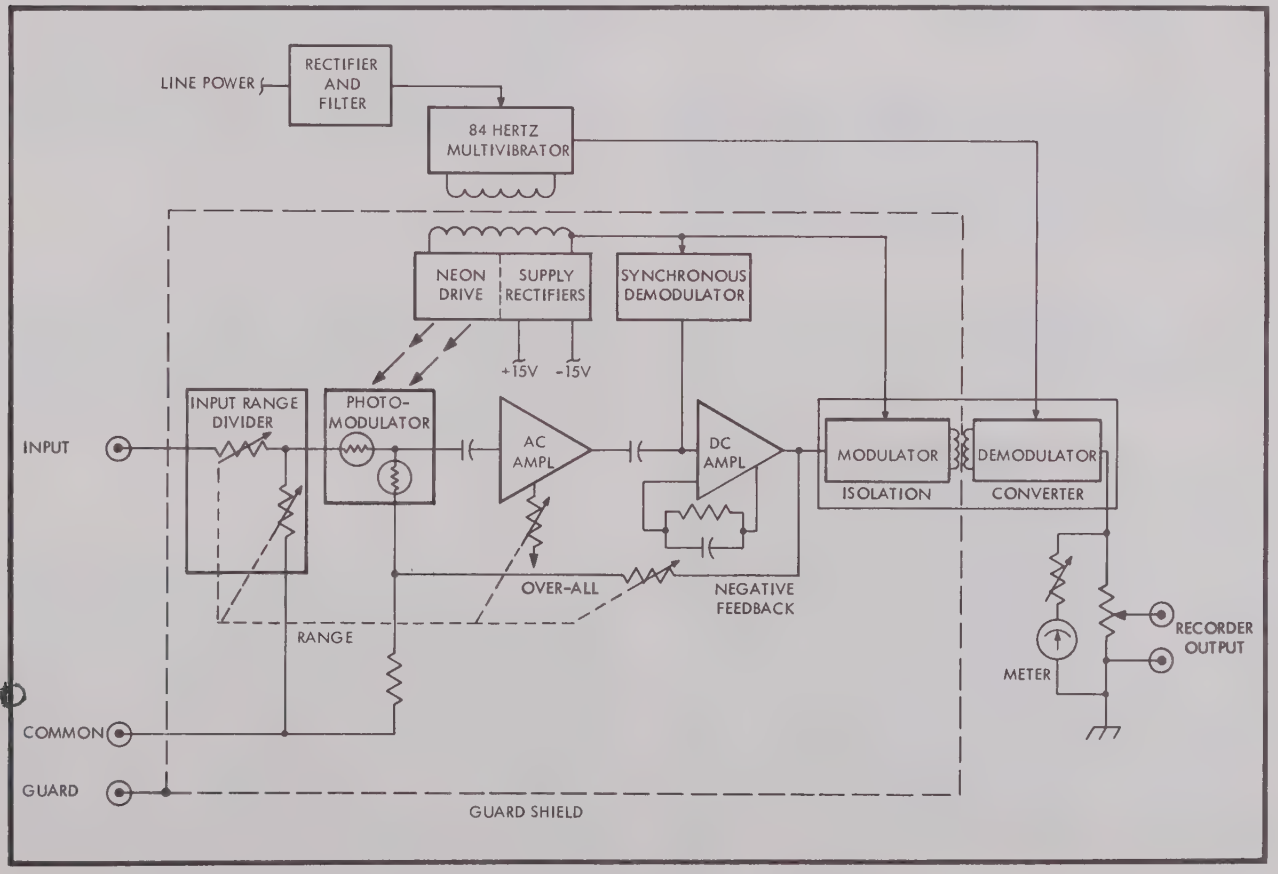


Figure 3-1. MODEL 845AR BLOCK DIAGRAM

multivibrator. Eighty four Hz is used to provide the Model 845 with an operating frequency asynchronous with the power line frequency and its harmonics. The 84 Hz multivibrator also drives the following circuits; (1) the supply rectifiers which provide operating voltages for the amplifiers, (2) the synchronous demodulator which demodulates the amplified dc signal, (3) the isolation converter which produces the meter and isolated recorder output. The entire amplifier and the secondaries of both transformers are surrounded by a guard shield which permits the use of external guard voltages.

3-6. The ac amplifier is a high impedance amplifier whose gain is controlled by the resistance selected by the RANGE control. The amplified dc signal is then detected by the synchronous demodulator.

3-7. The synchronous demodulator is driven by the 84 Hz reference signal and detects the amplified dc signal. The detected dc signal is then amplified by a dc amplifier whose gain is controlled by fixed feedback. The output signal of the dc amplifier is applied to the isolation converter which drives the isolated recorder output, and the meter which indicate the polarity and magnitude of the measured voltage. This same dc signal is also fed back to the input of the ac amplifier to control overall amplifier gain. The feedback ratio is determined by the setting of the RANGE control and allows overall amplifier gain to be precisely controlled.

3-8. CIRCUIT DESCRIPTION

3-9. POWER SUPPLY

3-10. Input power transformer T201 receives 115 volts ac, or 230 volts ac if the instrument is so wired, through the power switch, S1. The primary winding of T201 is constructed in such a manner as to utilize either 115 volts ac input, windings parallel, or 230 volts ac, windings in series. Fuse, F1, protects the Model 845AR circuitry from overloads.

3-11. The secondary voltage of T201 is rectified by bridge rectifier CR201 through CR204. The bridge rectifier output voltage is filtered by C201 and regulated by zener CR207. This regulated output voltage is used as the operating voltage for the 84 Hz multivibrator.

3-12. The 84 Hz multivibrator is used to provide synchronous drive voltages and dc operating voltages for the Model 845AR amplifier circuits free from any power line frequency variations and harmonics. The multivibrator is a transformer-coupled free running multivibrator composed of transistors Q201 and Q202, transformer T202, and frequency determining components C203 and R206 through R208. Variable resistor R206 is used to adjust the frequency of the multivibrator to 84 Hz. The voltage at the secondary of T202 is rectified by CR104 and CR105 to produce the positive and negative 15 volt dc operating voltages for the amplifier circuits. The same winding furnishes the synchronous demodulator and isolation converter drive signals and is tapped at a higher voltage level to drive the neon lamps DS101 and DS102. These neon lamps provide the drive signal for the photocell modulators V101 and V102.

3-13. INPUT DIVIDER

3-14. The basic full-scale sensitivity of the Model 845AR is limited to a maximum of 1 millivolt. Therefore, input signals above this value must be reduced. The input divider consists of R101 through R109 and RANGE switch S101A. On ranges being a multiple of 1, input voltages above 1 millivolt are divided down to 1 millivolt or less, upon selection of the proper range. On ranges being a multiple of 3, input voltages above 1 millivolt are divided down to 300 microvolts or less, upon selection of the proper range. On ranges of 1 millivolt and below, a 10 megohm resistor, R104, is connected across the input to provide a fixed value of input impedance.

3-15. AC AMPLIFIER

3-16. The input signal from the input divider is filtered by a three stage, low-pass filter composed of R110, C101, R111, C102, R112, and C103. This filter reduces any ac voltage having a frequency above 1 Hz. The filtered dc voltage is then square-wave modulated by photocell modulators V101 and V102, which are driven by DS101 and DS102. The resulting square-wave signal is coupled through C104 and amplified by Q101, Q102, and Q103 which form a three stage amplifier having a high input impedance. The gain of the ac amplifier is controlled by the common emitter resistance selected by the RANGE switch S101B. Maximum gain is used on the 1, 3, 10, and 30 microvolt ranges and is gradually reduced by the selection of R124 through R126 as the range is increased. The output of Q103 is capacitively coupled to a two stage current amplifier composed of Q104 and Q105. The current amplifiers have a constant gain controlled by fixed negative feedback through R130 and C111.

3-18. SYNCHRONOUS DEMODULATOR

3-19. The synchronous demodulator detects the magnitude and phase of the amplified signal. The 84 Hz drive signal is applied to the base of transistor Q106 which references the synchronous demodulator to the same phase as the photocell modulator. The demodulated signal is filtered by R134 and C114 before being applied to the dc amplifier.

3-20. DC AMPLIFIER

3-21. The dc amplifier amplifies the detected dc signal from the synchronous demodulator. Transistors Q107 through Q112 comprise a two-stage differential amplifier with a complementary emitter-follower output. Negative feedback through R149 and C116 is applied to the base of Q108 and controls the dc amplifier gain. The output from the common emitter of Q111 and Q112 is one volt dc for a full range input on any range, which drives the isolation converter. Overall negative feedback through the resistive network of R138 through R142 and R114 is controlled by the position of the RANGE switch S101C. This negative feedback allows precise control of the overall gain of the Model 845AR amplifiers.

3-22. ISOLATION CONVERTER

3-23. The isolation converter drives the recorder output and meter while providing isolation from the Model 845 amplifier circuitry. The output signal from the amplifier is applied to the transistors Q113 and Q114. An 84 Hz reference drive signal is applied to the bases of transistors Q113 and Q114 which causes modulation of the dc input signal to occur. The resulting modulated signal is coupled to the secondary of T203 where transistors Q203 and Q204 demodulate secondary signals occuring at their 84 Hz base signal rate. Capacitor C204 charges to the peak of the demodulated signal and discharges through the OUTPUT LEVEL control R1, R211 through R213, and the meter M1. The meter M1 indicates the polarity and magnitude of the input voltage. Capacitor C3 and resistor R2 filter the resulting dc output voltage for the recorder output.

SECTION IV

MAINTENANCE

4-1. GENERAL

4-2. The Model 845AR should be checked for calibration annually. Without extreme abuse all that should be required is periodic cleaning and calibration as specified in this section. If a problem arises, the information on corrective maintenance in this section will be extremely useful.

4-3. TEST EQUIPMENT

4-4. Figure 4-1 lists the recommended equipment with their specifications which are required for corrective maintenance and calibration.

4-5. 230 VOLT AC POWER-LINE CONVERSION

4-6. The Model 845AR may be converted for operation on 230 volt ac lines by modifying the power supply P/C board assembly wiring. Factory modified versions will have a decal on the rear panel indicating 230 volts ac input requirements.

4-7. To convert the Model 845AR to 230 volts ac operation, proceed as follows:

a. Remove the top-back dust cover.

b. Locate T201 on the power supply P/C board assembly and remove the two jumper wires labeled 115V. Refer to Figure 4-2 for location of jumper wires.

c. Place the jumpers removed in step b across the 230V labeled terminals, refer to Figure 4-2 for location, and solder the connections.

d. Replace the top-back dust cover and install a 3AG 1/32 ampere fuse in place of F1. F1 is located on the front panel.

4-8. DISASSEMBLY INSTRUCTIONS

4-9. The following procedure is to be used to gain access to the inside of the Model 845AR:

a. Remove the top-back cover by removing eight screws, six on top and two on the back. This allows access to the parts on the power supply board, and to capacitors C1 and C2 located on the front panel.

b. Remove the top cover of the guard chassis by removing six screws, three on the top of the guard and three on the back. This allows access to the dc amplifier and the last two stages of the ac amplifier. The instrument will still operate properly with the top of the guard chassis removed.

c. Remove the screws that fasten the right side panel to the front panel and other chassis panels, and remove the right side panel from the instrument.

d. Remove the two remaining screws holding the power supply P/C board. This will allow movement of the board assembly.

EQUIPMENT NOMENCLATURE	SPECIFICATIONS	RECOMMENDED EQUIPMENT
DC POWER SUPPLY	Output voltage of 0 to 1000 volts dc. Accuracy of ±0.25% or 100 microvolts.	Fluke Model 332A.
Oscilloscope	Voltage sensitivity of 200 uv/cm.	Hewlett-Packard Model 130C.
Battery	10 volt.	

Figure 4-1. TEST EQUIPMENT REQUIREMENTS

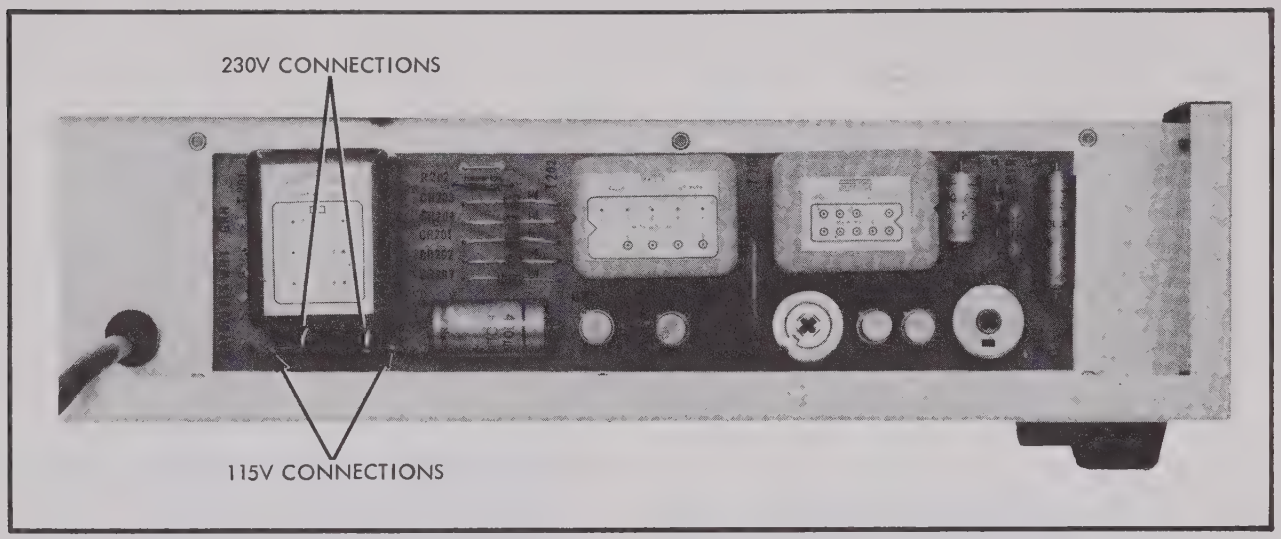


Figure 4-2. T201 115/230 VOLT AC POWER TERMINALS

e. Remove the bottom-back cover of the guard chassis by removing the three screws on the bottom of the guard chassis. This allows access to the input divider, the plus and minus 15 volts dc filter capacitors, and the isolation convertor modulator.

CAUTION!

Avoid touching the polyethelene grommets. Contamination will cause excessive electrical leakage.

4-10. CORRECTIVE MAINTENANCE

4-11. TROUBLESHOOTING

4-12. The purpose of troubleshooting is to locate and correct as quickly as possible any deficiency in operation. The causes and remedies of the more common troubles that may occur are listed in the troubleshooting chart, Figure 4-3. Waveforms useful for troubleshooting are given in Figures 4-4 through 4-9. A complete understanding of the theory of operation and familiarity with the schematic diagram is the best way to locate and correct the cause of any malfunction.

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Blows fuses.	Short circuit across secondary of T201.	Test for short circuit between pins 3 and 6.
	Shorted turn in T201.	Unsolder R202 in secondary of T201. A shorted turn will require almost as much current as normal operation.
	Defective CR201 through CR206.	Measure voltage of C201. Should be 10.5 volts. If near zero, replace CR201 through CR206, as necessary.
Photo Modulator inoperative. (Neon lights out)	Defective Q201 or Q202.	If voltage of C201 is less than 7 volts, and batteries are charged, replace Q201 and/or Q202.
	Open winding on T202, or open C203.	Waveform of TP10 should agree with Figure 4-4. If square wave is absent, T202 or C203 is defective.
	No drive to neon lamps DS101 and DS102.	A square wave of over 200 volts peak-peak should be present between pin 9 of T202 and the GUARD terminal. If not, T202 may be defective.

Figure 4-3. TROUBLESHOOTING CHART (Sheet 1 of 3)

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Meter movement inoperative.	Dead meter. Defective auxiliary supply.	Check meter with an ohmmeter. Panel meter should peg. Measure voltages at TP3 and TP4. If one voltage is near zero, check the associated diode and capacitor. If both voltages are zero, T202 is defective.
Meter pegs or wanders.	Meter mechanically stuck. Defective amplifier	Using an oscilloscope with dc coupling, measure waveforms at TP6. If waveforms agree with Figure 4-5 check Q111, Q112, Q109, Q110, Q107, and Q108 by replacement. If waveforms are not correct, then: (a) Waveform at TP6 looks more like waveform at TP7, Figure 4-6, Q106 is open. (b) No change in waveform at TP6 as ZERO control is rotated. R114 is shorted, base of Q101 is shorted, V101 or V102 is shorted. (c) Waveform at TP6 looks like a square wave. Measure waveform at TP7. If square wave disappears and waveform at TP7 is correct, C112 is shorted. If waveform is not correct, remove Q104 and measure waveform at TP2, Figure 4-7. If square wave persists, short junction of R115, C104, C105, and base of Q101 to common. If square wave disappears, remove short and transfer short to R112, C103, and V101 junction. If square wave returns, a photocell is defective, or C104 is shorted. If square wave does not return, move the short to the end of R110 that connects to RANGE switch. If signal reappears, CR101 or CR102 is defective. If square wave does not reappear, the RANGE switch is defective. (d) No signal at TP6. If there is also no signal at TP7, Q106 is probably shorted. If Q106 is satisfactory, measure waveform at TP2. If there is still no signal, C107, CR103, Q101, Q102, or Q103 is defective.
Erratic or unstable condition when measuring a voltage or zeroing instrument.	S103 Erratic Contact.	Replace or burnish contacts with crocus cloth.
Meter deflects in one direction, only.	Open winding on T203, defective Q113, Q114, Q203, or Q204.	Check and replace as necessary.
Slower response in negative direction.	Leaky C120.	Test and replace if necessary.
Measurements are low on high-sensitivity.	Shorted C116.	Test and replace if necessary.
Poor stability.	Defective CR207.	Replace if necessary.

Figure 4-3. TROUBLESHOOTING CHART (Sheet 2 of 3)

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Noise on 1, 3, and 10 uv ranges.	Dirty or defective Q101, or defective Q102. Defective chopper	Measure waveform at TP2. Figure 4-9 waveform shown is normal. Additional noise at TP2 is due to dirty Q101 or defective Q102. Remove Q111 and Q112, and apply an input of 1 mv. Observe waveform at TP1. For waveform shown in Figure 4-9: (a) Excessive noise can be caused by poor positioning of neon lamps. (b) Smaller waveform can be caused by slow response of photocells; if so, replace cells.
Unguarded leakage poor.	Dirty grommets. Leakage in T202 or T203.	Clean according to paragraph 4-15. Test and replace if necessary.
Guarded leakage poor	Leakage in T202 or T203, or pins touching circuit board. Contaminated binding posts.	Test and repair as necessary. Clean according to paragraph 4-15.
Poor overload recovery.	Defective C101, C102, C103, C120, CR101, CR102, or R110.	Test and replace as necessary.

Figure 4-3. TROUBLESHOOTING CHART (Sheet 3 of 3)

4-13. VISUAL INSPECTION

4-14. Troubles may sometimes be located by a thorough visual inspection. This may be accomplished by looking for the following symptoms:

a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in paragraph 4-15.

b. Scorched or burned parts. Damage of this type is usually caused by other defective components. Determine the cause of damage before replacing components.

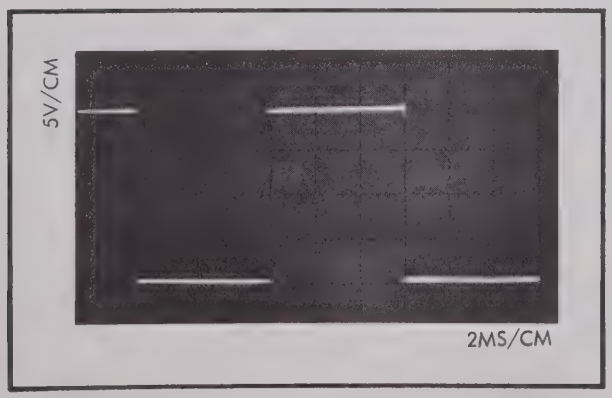


Figure 4-4. WAVEFORM AT TP10

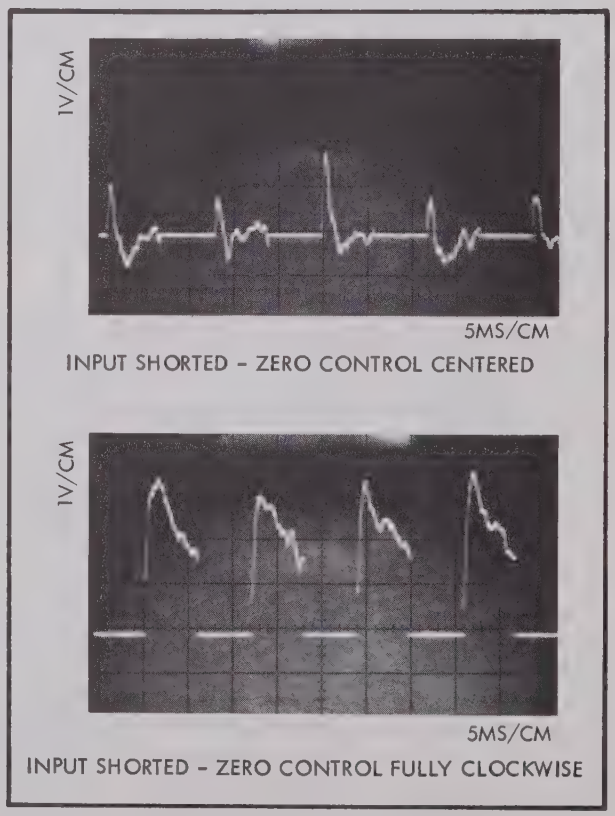


Figure 4-5. WAVEFORMS AT TP6

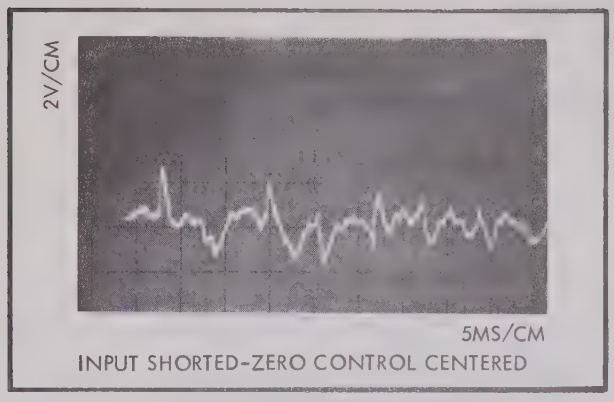


Figure 4-6. WAVEFORM AT TP7

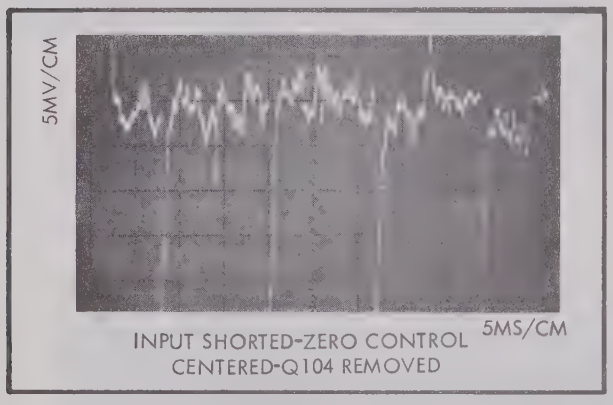


Figure 4-7. WAVEFORM AT TP2 - Q104 REMOVED

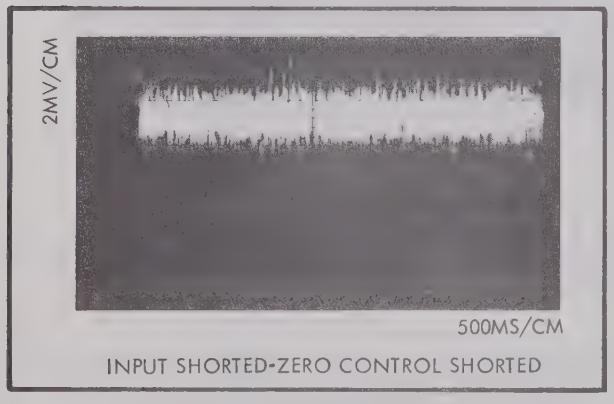


Figure 4-8. WAVEFORM AT TP2

c. Cracks, cuts, and other damage to the polyethelene grommets or to the circuit boards.

CAUTION!

Do not touch the polyethelene grommets. Contamination will cause excessive electrical leakage.

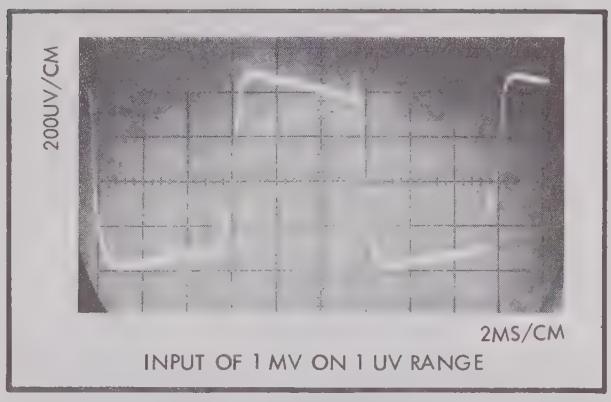


Figure 4-9. WAVEFORM AT TP1

4-15. PERIODIC MAINTENANCE

4-16. Periodic maintenance consists of occasional cleaning to remove dust, grease, and other contaminations.

4-17. To clean the instrument proceed as follows:

a. Remove accumulations of dust and other foreign matter with low-pressure, clean dry air.

b. Clean binding posts and front panel with denatured alcohol, and if necessary, a clean cloth or cotton swab. Do not attempt to clean switches.

4-18. LEAKAGE RESISTANCE TEST

4-19. The following leakage test is to be used to check the leakage resistance of the Model 845. Failure of the instrument to meet the test indicates the need of cleaning or troubleshooting.

a. Connect the equipment as illustrated in Figure 4-10.

b. Place the Model 845 controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	300 MICROVOLTS

c. For a leakage resistance of 10^{12} ohms, the panel meter must not indicate more than 100 microvolts. Allow sufficient time for the meter deflection to stabilize.

4-20. CALIBRATION PROCEDURES

4-21. The Model 845 should be calibrated once every year. It is recommended that if component replacement is performed, the Model 845 should be re-calibrated. Test and alignment points are illustrated by Figure 4-11.

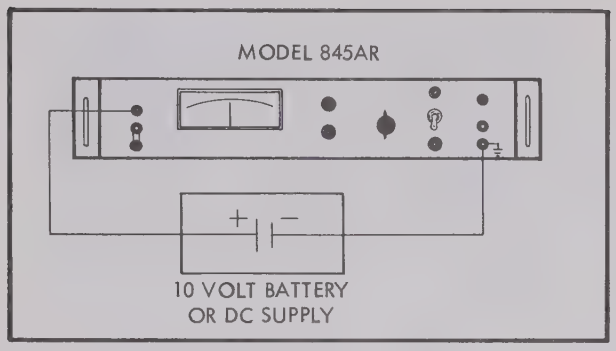


Figure 4-10. LEAKAGE RESISTANCE TEST EQUIPMENT CONNECTIONS

4-22. METER CALIBRATION

4-23. Connect the equipment as illustrated in Figure 4-12 and proceed as follows:

Note!

Allow equipment to warm up for at least 5 minutes.

a. Place the Model 845 controls as follows:

POWER	ON
OPR/ZERO	OPR
RANGE	10 VOLTS

b. Adjust the Model 332 output for 10 volts dc.

c. Adjust R151 for a full-scale deflection (+10) on the Model 845 meter.

4-24. CHOPPER FREQUENCY

4-25. To adjust the 84 Hz multivibrator frequency, proceed as follows:

a. Place the Model 845 POWER switch to ON.

b. Connect an oscilloscope between TP10 and ground.

c. Adjust R206 until the oscilloscope waveform has a time period of 12 milliseconds, as illustrated in Figure 4-5.

Note!

A frequency counter may be used in lieu of the oscilloscope for adjustment of the 84 Hz multivibrator frequency.

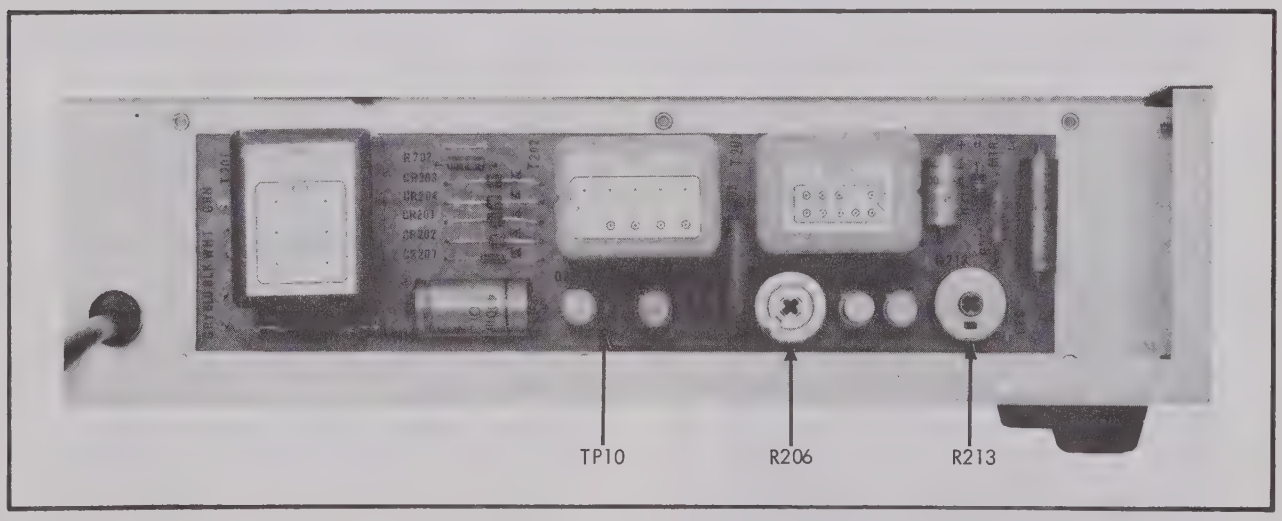


Figure 4-11. TEST AND ALIGNMENT POINTS

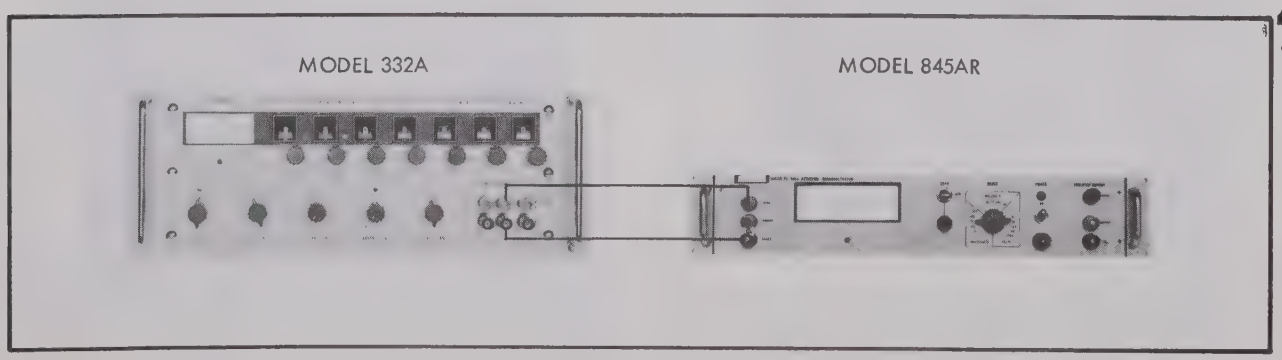


Figure 4-12. CALIBRATION EQUIPMENT CONNECTIONS

SECTION V

LIST OF REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section contains complete descriptions of those parts one might normally expect to replace during the life of the instrument. The first listing is a breakdown of all of the major assemblies in the instrument. Subsequent listings itemize the components in each assembly. Every listing where possible, is accompanied by an illustration identifying each component in the listing. Assemblies and subassemblies are identified by a reference designation beginning with the letter A, (e.g., A1, A2, A3, etc.). Components are identified by the schematic diagram reference designation (e.g. R1, C107, DS1). Flagnotes are used throughout the parts list and refer to ordering explanations. The flagnote explanations are located at the end of the parts list section in which they appear.

5-3. COLUMNAR INFORMATION

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations for the components of the subassembly may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the item description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, see paragraph 5-7.

c. The ten-digit part number by which the item is identified at the John Fluke Mfg. Co. is listed in the STOCK NO column. Use this number when ordering parts from the factory or authorized representatives.

d. The Federal Supply Code for the item manufacturer is listed in the MFR column. An abbreviated list of Federal Supply Codes is included in the Appendix.

e. The part number which uniquely identifies the item to the original manufacturer is listed in the MFR PART NO column. If a component must be ordered by description, the type number is listed.

f. The TOT QTY column lists the total quantity of the item used in the instrument. Second and subsequent listing of the same item are referenced to the first listing with the abbreviation REF. In the case of optional subassemblies, plug ins, etc. that are not always part of the instrument, the TOT QTY column lists the total quantity of the item in that particular assembly.

g. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of every part in the instrument be stocked.

h. The USE CODE column identifies certain parts which have been added, deleted or modified throughout the life of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Number Effectivity List at the end of the parts list. As Use Codes are added to the list, the TOT QTY column listings are changed to reflect the most current information. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part. In this event a parenthetical note is added in the DESCRIPTION column.

5-4. HOW TO OBTAIN PARTS

5-5. Standard components have been used wherever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co. factory or authorized representative by using the Fluke stock number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 4805-177105, Transistors, 2N3565, Q107-108 for 845AR, s/n 168.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part showing its location to other parts of the instrument is usually most helpful.

5-7. LIST OF ABBREVIATIONS

ac	alternating current
Al	Aluminum
amp	ampere
assy	assembly
cap	capacitor
car flm	carbon film
C	centigrade
cer	ceramic
comp	composition
conn	connector
db	decibel
dc	direct current
dpdt	double-pole, double-throw
dpst	double-pole, single-throw
elect	electrolytic
F	fahrenheit
Ge	germanium
gmv	guaranteed minimum value
h	henry
Hz	hertz
hf	high frequency
IC	integrated circuit
if	intermediate frequency
k	kilohm
kHz	kilohertz
kv	kilovolt
lf	low frequency
MHz	megahertz
M	megohm
met flm	metal film
ua	microampere
uf	microfarad
uh	microhenry
usec	microsecond
uv	microvolt
ma	milliampere
mh	millihenry
m	millohms
msec	millisecond
mv	millivolt
mw	milliwatt
na	nanoampere
nsec	nanosecond
nv	nanovolt
Ω	ohm
ppm	parts per million
piv	peak inverse voltage
p-p	peak to peak
pf	picofarad
plstc	plastic
p	pole
pos	position
P/C	printed circuit
rf	radio frequency
rfi	radio frequency interference
res	resistor
rms	root mean square
rtry	rotary
sec	second
sect	section
S/N	serial number
Si	silicon
scr	silcon controlled rectifier
spdt	single-pole, double-throw
spst	single-pole, single-throw
sw	switch
Ta	tantalum
tstr	transistor
tvm	transistor voltmeter
uhf	ultrahigh frequency
vtvm	vacuum tube voltmeter
var	variable
vhf	very high frequency
vlf	very low frequency
v	volt
va	voltampere
vac	volts, alternating current
vdc	volts, direct current
w	watt
ww	wire wound

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
	FINAL ASSEMBLY - Figure 5-1	845AR					
A1	Chassis Assembly (See Figure 5-2)						
A2	Front Panel Assembly (See Figure 5-3)						
A3	Amplifier P/C Assembly (See Figure 5-4)	1702-198028 (845AR-401)	89536	1702-198028	1		
A4	Power Supply P/C Assembly (See Figure 5-5)	1702-198036 (845AR-402)	89536	1702-198036	1		

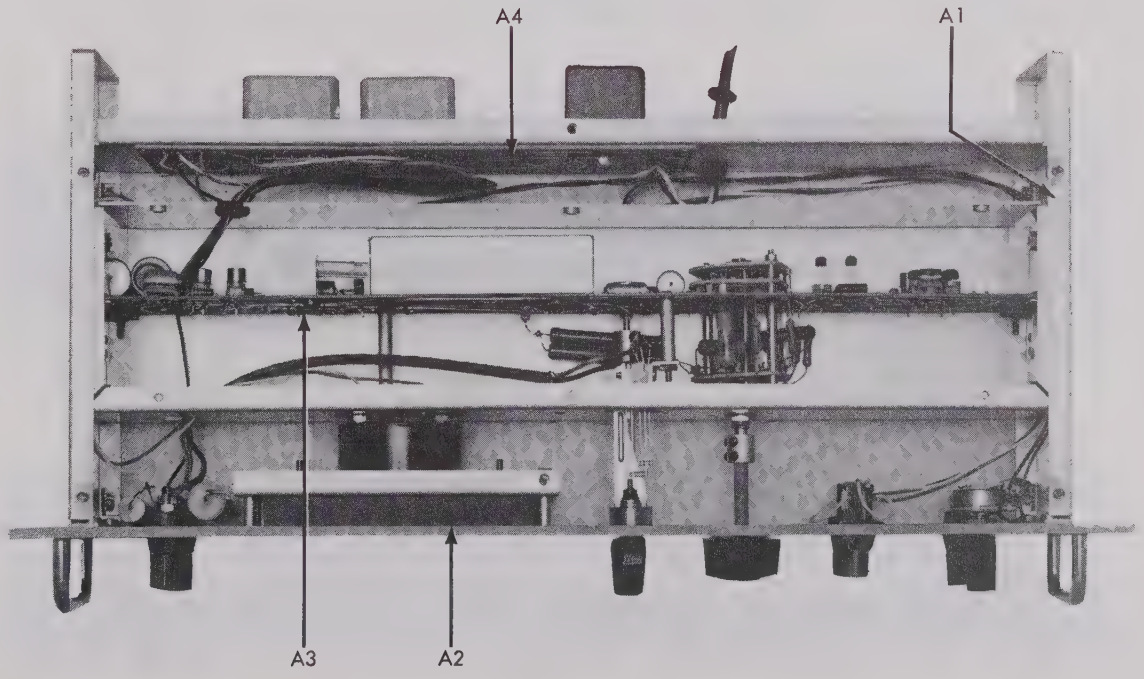


Figure 5-1. FINAL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A1	**CHASSIS ASSEMBLY - Figure 5-2**						
1	Coupler	2402-170506	80583	FC-46-S	1		
2	Coupler, 1/8" to 1/4" (not illustrated)	2402-193557	89536	2402-193557	1		
3	Cover, bottom (not illustrated)	3156-197533	89536	3156-197533	1		
4	Cover, top	3156-197525	89536	3156-197525	1		
5	Foot, rubber	2819-103309	77967	9102-W	4		
6	Line cord with plug	6005-102822	91934	019-3	1		
7	Shaft, range switch	3206-200998	89536	3206-200998	1		
8	Shaft, zero	3200-201012	89536	3200-201012	1		
9	Strain relief, 1/4"	2502-101162	28520	SR-5P-1	1		

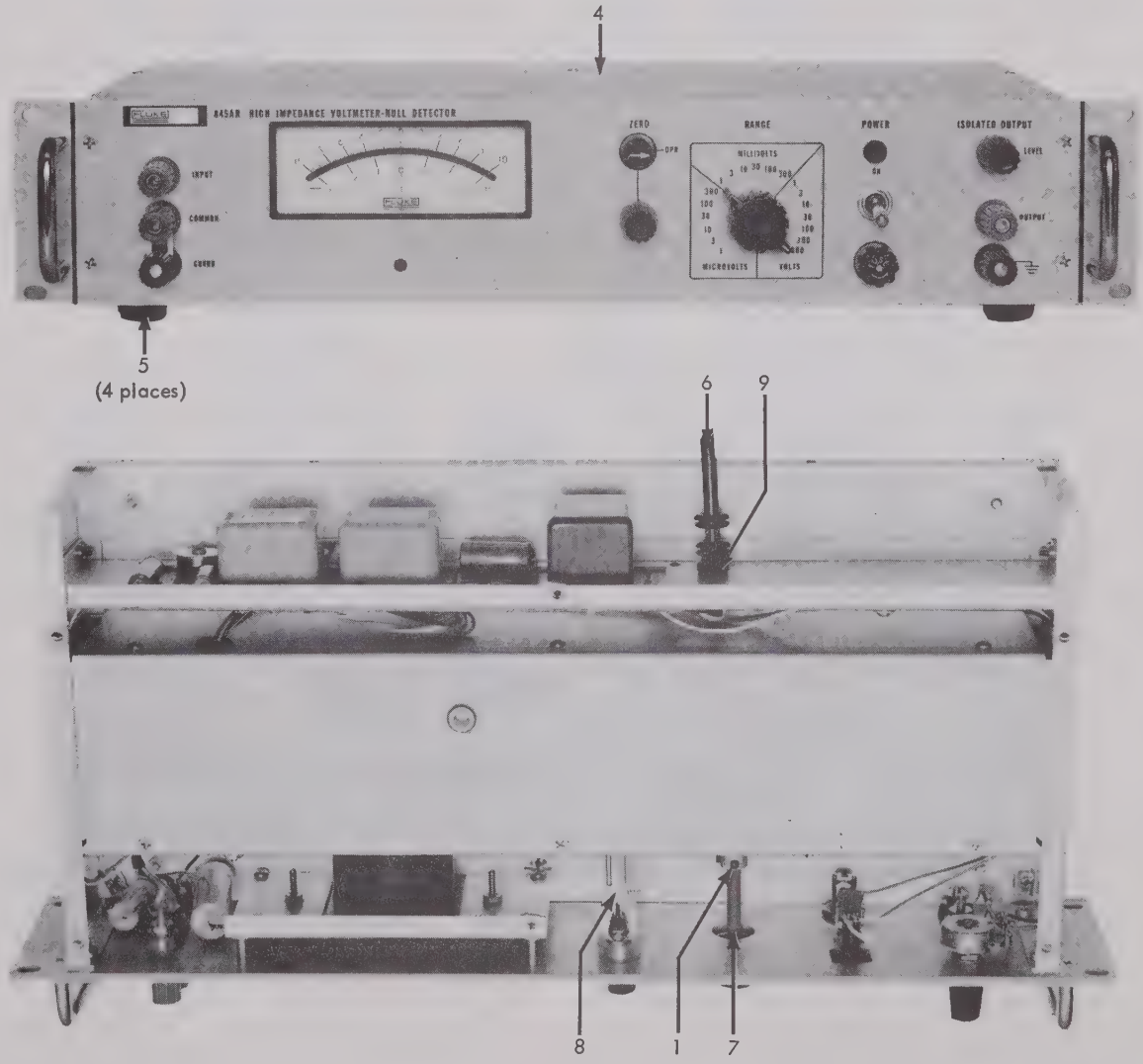


Figure 5-2. CHASSIS ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A2	**FRONT PANEL ASSEMBLY-Figure 5-3**						
C1,C2	Cap, mylar, 0.047 uf ±20%, 1200v	1507-182683	72928	343-087M	2		
C3	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	3	1	
DS1	Indicator, Neon 115v	3903-193524	08717	858-R-A/C-68K	1	1	
F1	Fuse, Type MDL, slow-blow, 1/16 amp, 250v (for 115v operation) (not illustrated)	5101-163030	71400	Type MDL	1	5	
F1	Fuse, Type MDL, slow-blow, 1/32 amp, 250v (for 230v operation) (not illustrated)	5101-163022	71400	Type MDL	1	5	
J1, J2	Binding post, red, INPUT & COMMON	2811-149856	58474	BHB-10208-G22	2		
J3	Binding post, black, GUARD	2811-142984	58474	DF31BC	2		
J4	Binding post, red, RECORDER OUTPUT	2811-142976	58474	DF31RC	1		
J5	Binding post, black, RECORDER	2811-142984	58474	DF31BC	REF		
M1	Meter, 100-0-100 ua, 750Ω	2901-192302	55026	524	1		
R1	Res, var, 10k ±30%, 1/3w	4701-192344	71450	WF-45	1		
R2	Res, comp, 4.7k ±10%, 1/2w	4704-108381	01121	EB4721	1		
S1	Switch, toggle, spst, POWER	5106-114850	04009	20994-LH	1		
XF1	Holder, Fuse	2102-160846	75915	342004	1		
10	Handle	2404-100412	05704	825	2		
11	Knob, RANGE	2405-170035	89536	2405-170035	1		
12	Knob, ZERO, LEVEL	2405-158949	89536	2405-158949	2		
13	Panel, front	1406-197475	89536	1406-197475	1		
14	Shorting link	2811-190728	24655	938LG	1		

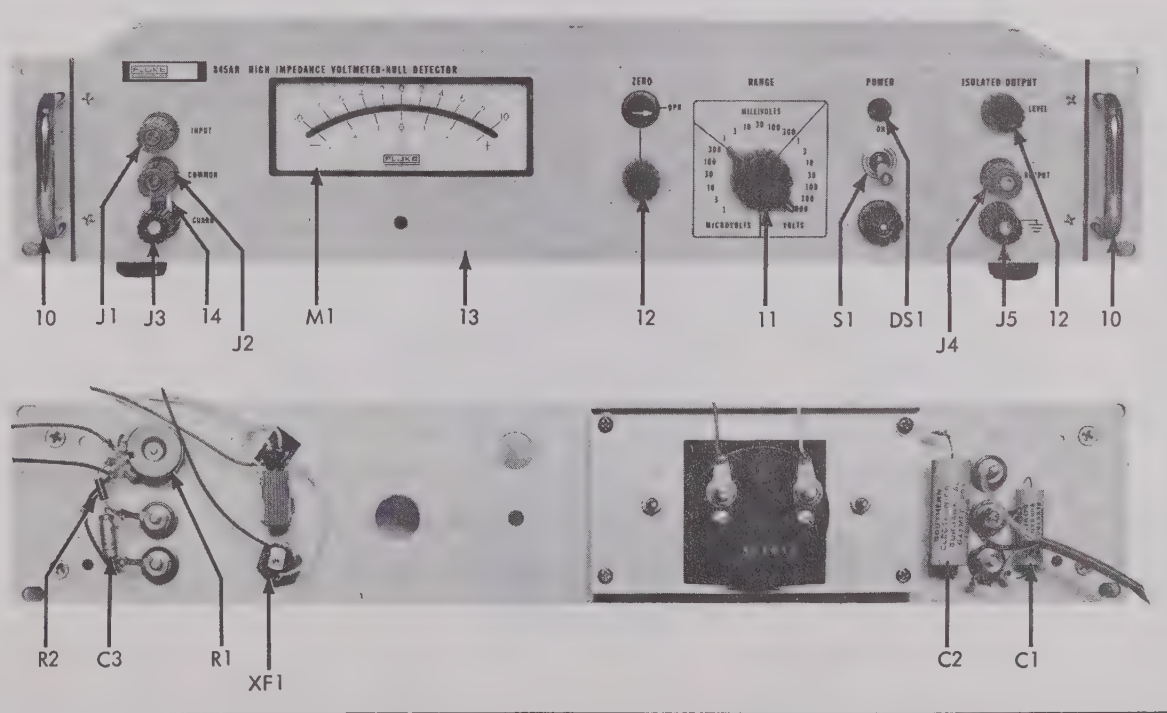


Figure 5-3. FRONT PANEL ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A3	**AMPLIFIER P/C ASSEMBLY - Figure 5-4**	1702-198028 (845AR-401)	89536	1702-198028	REF		
C101 thru C103	Cap, poly, 0.47 uf ±20%, 120v	1507-190553	84411	JF-36	3		
C104	Cap, mylar, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	3		
C105	Cap, cer, 300 pf ±10%, 500v	1501-105734	71590	BB60301KW7W	2		
C106	Cap, elect, 1250 uf +50/-10%, 4v	1502-166330	73445	C437ARB1250	1	1	
C107	Cap, elect, 250 uf +50/-10%, 16v	1502-187765	73445	C434ARE250	2	1	
C108	Cap, cer, 300 pf ±10%, 500v	1501-105734	71590	BB60301KW7W	REF		
C109	Cap, mylar, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	REF		
C110	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF	1	
C111	Cap, mylar, 0.0047 uf ±20%, 200v	1507-106054	56289	192P47202	1		
C112	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C113	Cap, elect, 400 uf +50/-10%, 4v	1502-187773	73445	C426ARB400	2	1	
C114	Cap, Ta, 10 uf ±10%, 20v	1508-160259	05397	K10C20K	1		A
C114	Cap, Ta, 6.8uf ±10%, 35v	1508-182782	05397	K6R8C35K	1		B
C115	Cap, mylar, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	REF		
C116	Cap, Ta, 22 uf ±10%, 15v	1508-182816	05397	K22C15K	1		A
	Cap, Ta, 15uf±10%, 20v	1508-153056	05397	K15C20K	1		B
C117, C118	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	3	1	
C119	Cap, mylar, 0.22 uf ±20%, 250v	1507-194803	73445	C280AE/P220K	1		
CR101, CR102	Diode, Cont. Devices Type CD12599	4802-180554	07910	CD12599	2	1	
CR103	Diode, Type 1N961A	4803-113324	07910	Type 1N961A	2	1	
CR104 thru CR107	Diode, Inter. Rect. Type 4D4	4802-180240	81483	Type 4D4	8	2	
DS101, DS102	Light, Neon, NE2U (not illustrated)	3902-162602	89730	NE2U	2	5	
L1	Ferrite bead	2503-219535	02114	56-060-85-3B	1		B
Q101	Tstr, Selected ST-1750T	4805-194456	89536	4805-194456	1	1	
Q102	Tstr, Selected Type S19254	4805-168716	07263	S19254	1	1	
Q103	Tstr, Type 2N3391	4805-168708	09213	2N3391	1	1	
Q104, Q105	Tstr, Type 2N3565	4805-177105	07263	2N3565	4	1	
Q106	Tstr, T.I. Type GA3938	4805-182709	01295	GA3938	2	1	
Q107, Q108	Tstr, Type 2N3565	4805-177105	07263	2N3565	REF		
Q109, Q110	Tstr, Cont. Device Type CS-30011	4805-169375	07910	CS-30011	2	1	
Q111	Tstr, Type 2N1304	4805-117127	01295	2N1304	1	1	
Q112	Tstr, Type 2N1305	4805-190298	01295	2N1305	1	1	
Q113	Tstr, T.I. Type GA3938	4805-182709	01295	GA3938	REF		
Q114	Tstr, T.I. Type GA3937	4805-182691	01295	GA3937	3	1	
R101	Res, car flm, matched set	1					
R102	Res, car flm, 900k ±1/2%, 1/2w	4703-107391	19701	DC1/2A	1		
R103	Res, car flm, matched set	1					
R104	Res, car flm, 10 meg ±1/2%, 1w	4702-107748	19701	DC1	1		
R105 thru R109	Res, car flm, matched set	1					
R110	Res, car flm, 300k ±1%, 2w	4703-107425	12400	Type C30	2		

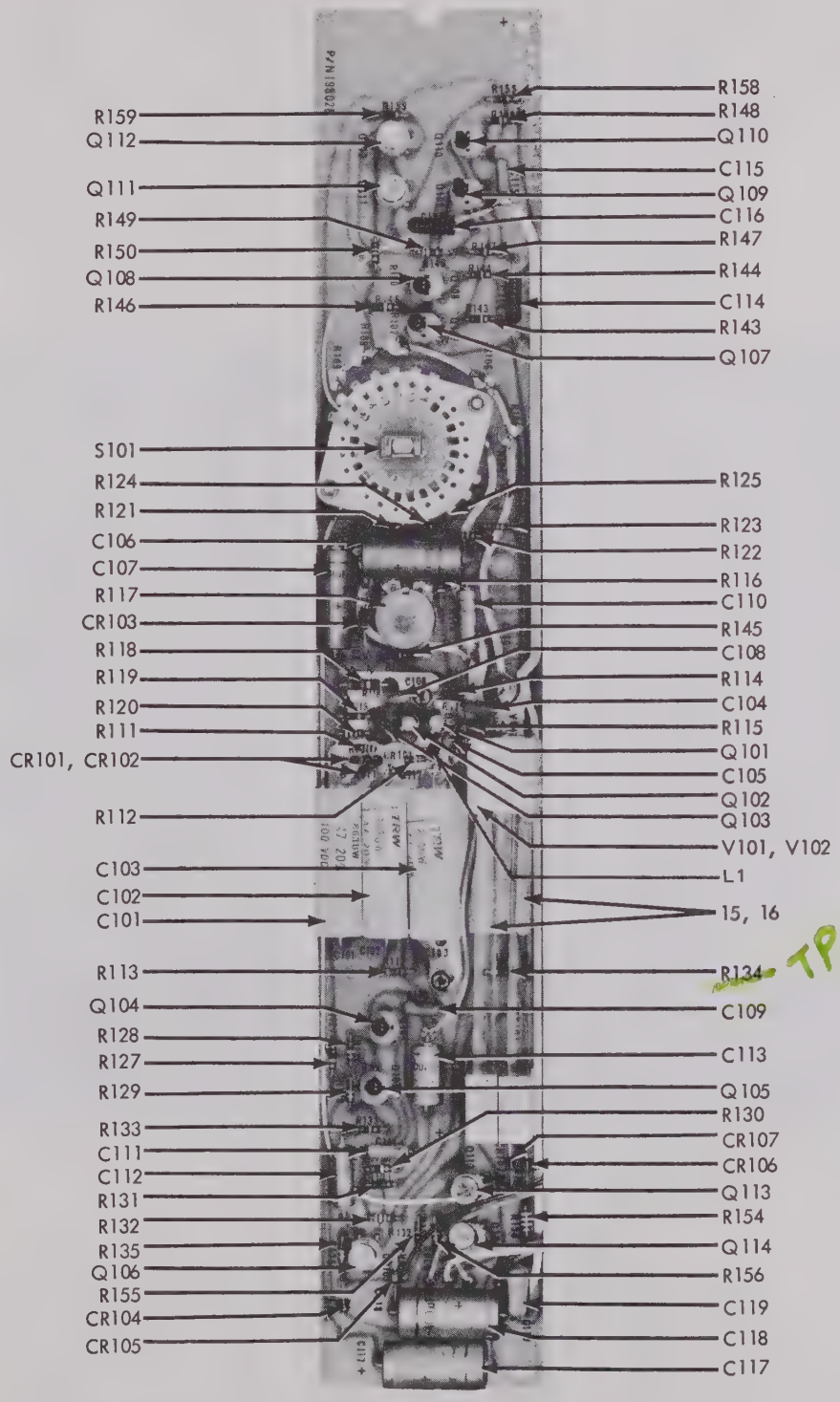
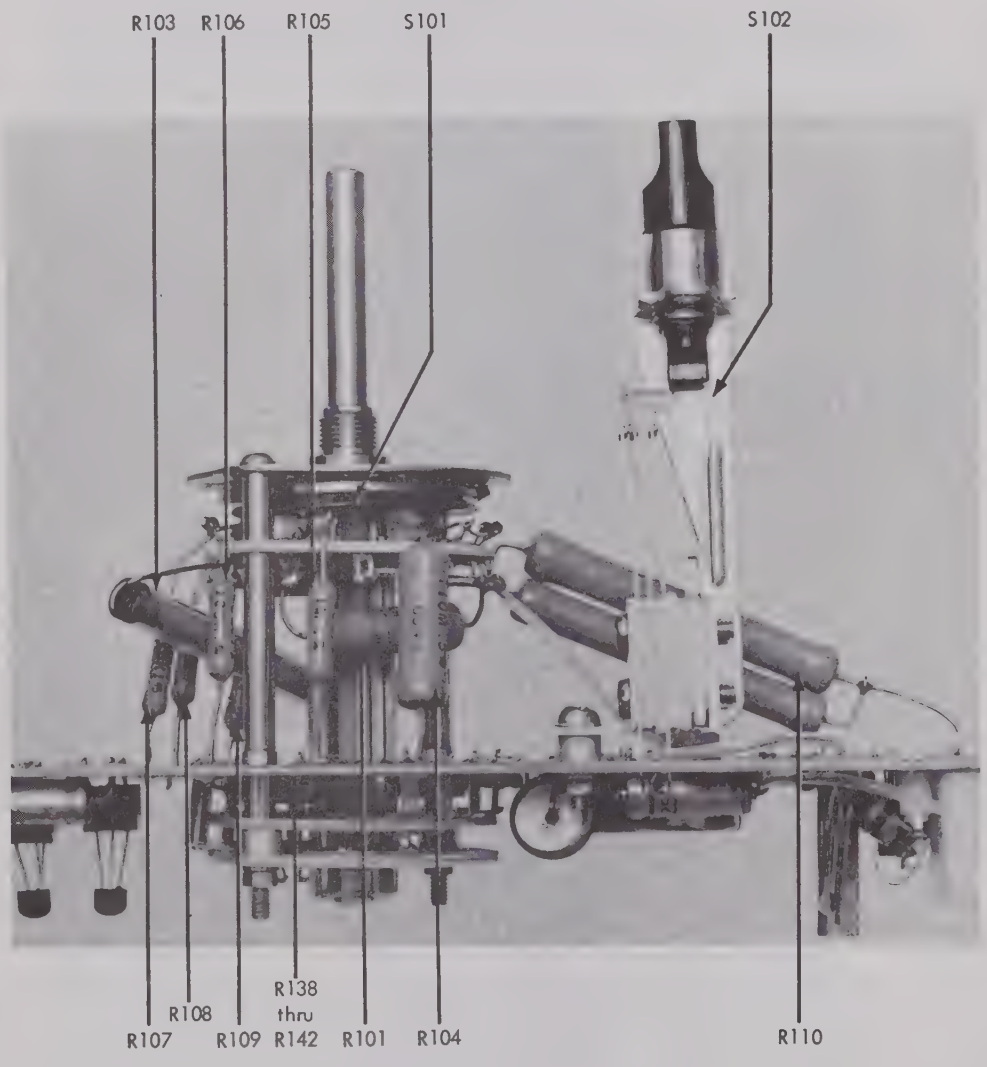


Figure 5-4. AMPLIFIER P/C ASSEMBLY (Sheet 1 of 2)



SIDE VIEW

Figure 5-4. AMPLIFIER P/C ASSEMBLY (Sheet 2 of 2)

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R111	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	2		
R112	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	4		
R113	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	1		
R114	Res, ww, 10Ω ±1%, 1/2w	4707-193946	89536	4707-193946	1		
R115	Res, comp, 1.2 meg ±10%, 1/2w	4704-108407	01121	EB1251	1		
R116	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	1		
R117	Res, var, 5 meg ±30%, 0.2w	4701-193086	71450	U-70	1		
R118	Res, comp, 10 meg ±10%, 1/2w	4704-108142	01121	EB1061	1		
R119	Res, comp, 2.2 meg ±5%, 1/4w	4704-198390	01121	CB2255	1		
R120	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R121	Res, comp, 10Ω ±5%, 1/4w (not illustrated)	4704-147868	01121	CB1005	1		
R122	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	2		
R123	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	1		
R124	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R125	Res, comp, 68Ω ±5%, 1/4w	4704-147918	01121	CB6805	1		
R126	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R127	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	2		
R128	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R129	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	5		
R130	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R131	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	1		
R132	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	1		
R133	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R134	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	2		
R135	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R136	Res, met flm, 1.07k ±1%, 1/2w (not illustrated)	4705-187930	12400	Type CEC-TO	1		
R137	Res, met flm, 3.16k ±1%, 1/2w (not illustrated)	4705-187781	12400	Type CEC-TO	1		
R138 thru R142	Res, met flm, matched set	▷2◁					
R143 thru R145	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	3		
R146	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R147	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R148	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R149	Res, comp, 3.9 meg ±5%, 1/4w	4704-188417	01121	CB3955	1		
R150	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	REF		
R154	Res, comp, 33k ±5%, 1/2w	4704-108761	01121	EB3331	1		
R155, R156	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R158, R159	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	2		
S101	Switch, rotary, RANGE	5105-194589	89536	5105-194589	1		
S102	Switch, twist, spdt, ZERO-OPERATE	5105-194936	89536	5105-194936	1		
V101, V102	Photo cell assembly	3700-194449	89536	3700-194449	1		
15, 16	Rod, optical	3800-168047	89536	3800-168047	2		

▷1◁ These resistors are factory matched. If any replacement is required, an entire set, part number 4710-227132, must be replaced.

▷2◁ These resistors are factory matched. If any replacement is required, an entire set, part number 4710-194423, must be replaced.

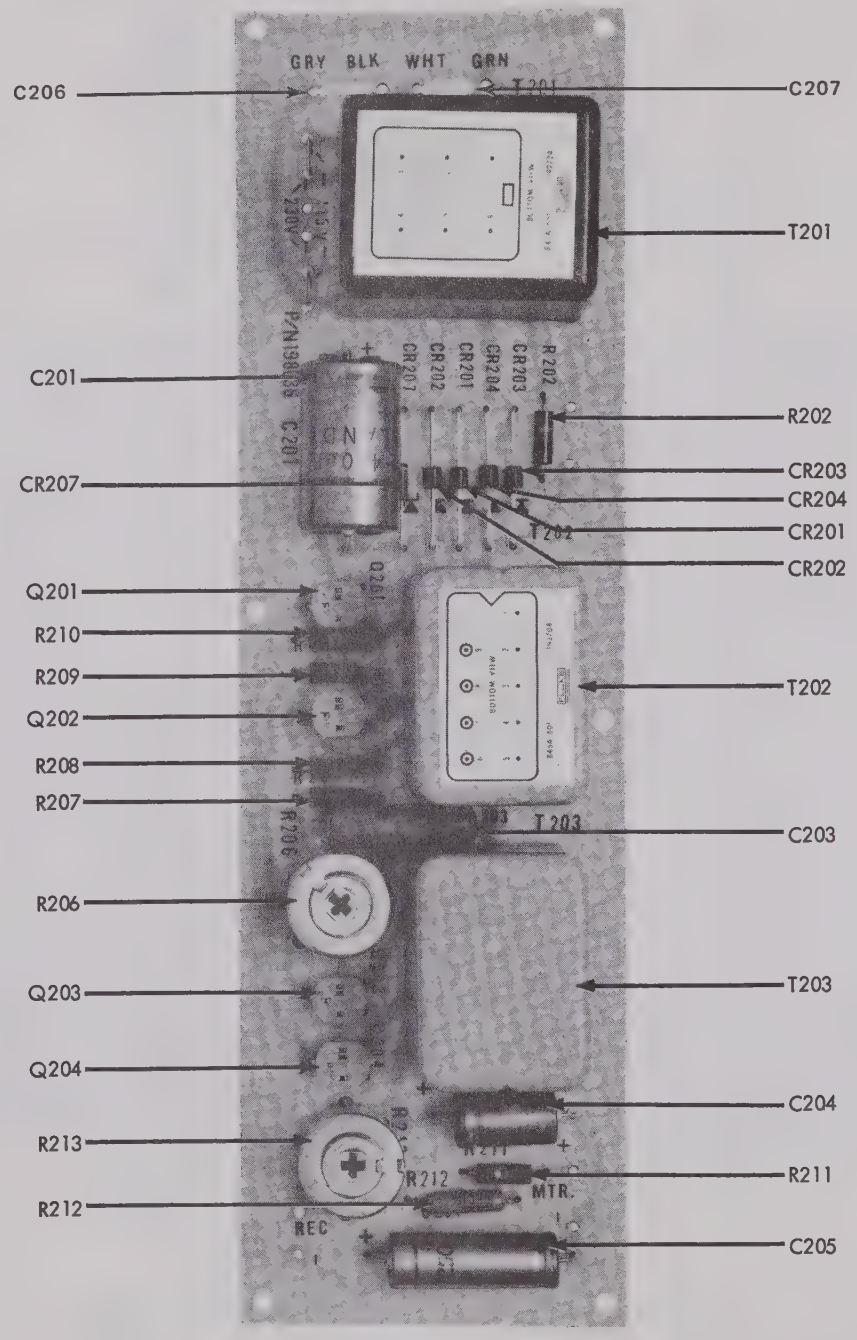


Figure 5-5. POWER SUPPLY P/C ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A4	**POWER SUPPLY P/C ASSEMBLY** **Figure 5-5**	1702-198036 (845AR-402)	89536	1702-198036	REF		
C201	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
C203	Cap, mylar, 1.0 uf ±20%, 250v	1507-190330	73445	C280AE/P1M	1		
C204	Cap, elect, 400 uf +50/-10%, 4v	1502-187773	73445	C426ARB400	REF		
C205	Cap, elect, 250 uf +50/-10%, 16v	1502-187765	73445	C437ARE250	REF		
C206, C207	Cap, mica, 0.001uf ±5%, 500v	1504-148387	14655	CD19F102J	2		B
CR201 thru CR204	Diode, Inter. Rect. Type 4D4	4802-180240	81483	4D4	REF		
CR207	Diode, Type 1N961A	4803-113324	07910	1N961A	1		
Q201, Q202	Tstr, T.I. Type GA2817	4805-182600	01295	GA2817	2	1	
Q203, Q204	Tstr, T.I. Type GA3937	4805-182691	01295	GA3937	REF		
R202	Res, comp, 150Ω ±5%, 1/2w	4704-186056	01121	EB1515	1		
R206	Res, var, ww, 2k ±5%, 1-1/4w	4702-160705	71450	Type 110	1		
R207, R208	Res, comp, 5.1k ±5%, 1/2w	4704-109108	01121	EB5125	2		
R209, R210	Res, comp, 22k ±10%, 1/2w	4704-108209	01121	EB2231	2		
R211	Res, comp, 1k ±10%, 1/2w	4704-108563	01121	EB1021	1		
R212	Res, met flm, 9.53k ±1%, 1/2w	4705-159442	12400	Type CEC-TO	1		
R213	Res, var, ww, 3k ±20%, 2w	4702-153429	71450	Type 115	1		
T201	Transformer, power	5600-192724	89536	5600-192724	1		
T202	Transformer, drive	5600-192708	89536	5600-192708	1		
T203	Transformer, isolation	5600-197400	89536	5600-197400	1		

5-8. SERIAL NUMBER EFFECTIVITY

5-9. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 845AR. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123. New codes will be added as required by instrument changes.

USE CODE	EFFECTIVITY
None	Model 845AR serial number 123 and on
A	Model 845AR serial number 123 thru 276 on.
B	Model 845AR serial number 277 and on.

Appendix A

Federal Supply Code for Manufacturers

A-1. CODE TO NAME

A-2. The following five digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213 Sage Electronics Corp.
Rochester, New York

00327 Welwyn International, Inc.
Westlake, Ohio

00656 Aerovox Corp.
New Bedford, Massachusetts

00686 Film Capacitors
Passaic, New Jersey

00779 AMP Inc.
Harrisberg, Pennsylvania

01121 Allen-Bradley Co.
Milwaukee, Wisconsin

01281 TRW Semiconductors
Lawndale, California

01295 Texas Instruments, Inc.
Semiconductor Components Div.
Dallas, Texas

01686 RCL Electronics Inc.
Manchester, New Hampshire

01730 Deleted

01884 Dearborn Electronics Inc.
Orlando, Florida

02114 Ferroxcube Corp.
Saugerties, New York

02606 Replaced by 15801

02660 Amphenol-Borg Elect. Corp.
Broadview, Illinois

02799 Arco Capacitors, Inc.
Torrence, California

03508 General Electric Co.
Semiconductor Products
Syracuse, New York

03614 Replaced by 71400

03651 Replaced by 44655

03797 Eldema Corp.
Compton, California

03877 Transitron Electronic Corp.
Wakefield, Massachusetts

03888 Pyrofilm Resistor Co., Inc.
Cedar Knolls, New Jersey

03911 Clairex Corp.
New York, New York

03980 Muirhead Instruments, Inc.
Mountainside, New Jersey

04009 Arrow Hart and Hegemen
Electronic Company
Hartford, Connecticut

04062 Replaced by 72136

04202 Replaced by 81312

04217 Essex Wire Corp.
Wire & Cable Div.
Anaheim, California

04221 Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222 Aerovox Corp. (H-Q)
Myrtle Beach, South Carolina

04645 Replaced by 75376

04713 Motorola Semiconductor Products Inc.
Phoenix, Arizona

05082 Replaced by 94154

05236 Jonathan Mfg. Co.
Fullerton, California

05277 Westinghouse Electric Corp.
Semiconductor Dept.
Youngwood, Pennsylvania

05278 Replaced by 43543

05397 Union Carbide Corp.
Electronics Div.
Cleveland, Ohio

05279 Southwest Machine & Plastic Co.
Los Angeles, California

05397 Union Carbide Corp.
Electronics Div.
New York, New York

05571 Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574 Viking Industries
Chaisworth, California

05704 Alac, Inc.
Glendale, California

05820 Wakefield Engineering Ind.
Wakefield, Massachusetts

06001 General Electric Company
Capacitor Department
Irmo, South Carolina

06136 Replaced by 63743

06473 Amphenol Space & Missile Sys.
Chatsworth, California

06555 Beede Electrical Instrument Co.
Penacook, New Hampshire

06739 Electron Corp.
Littletown, Colorado

06743 Clevite Corp.
Cleveland, Ohio

06751 Semcor Div., Components, Inc.
Phoenix, Arizona

06860 Gould National Batteries Inc.
City of Industry, California

06980 Varian-Eimac
San Carlos, California

07115 Replaced by 14674

07138 Westinghouse Electric
Corp., Electronic
Tube Division
Elmira, New York

07256 Silicon Transistor Corp.
Garden City, New York

07263 Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344 Bircher Co., Inc.
Rochester, New York

07792 Lerma Engineering Corp.
Northampton, Massachusetts

07910 Teledyne Corp.
(Continental Device)
Hawthorne, California

08225 Industro Transistor Corp.
Long Island City, New York

08530 Reliance Mica Corp.
Brooklyn, New York

08792 Discontinued

08806 General Electric Co.
Miniature Lamp Dept.
Cleveland, Ohio

08863 Nylomatic Corp.
Norrisville, Pennsylvania

08988 Skottie Electronics Inc.
Archbald, Pennsylvania

09353 C and K Components
Watertown, Massachusetts

09423 Scientific Components, Inc.
Santa Barbara, California

09922 Burndy Corp.
Norwalk, Connecticut

11236 CTS of Berne
Berne, Indiana

11237 Chicago Telephone of
Calif., Inc. (CTC)
Paso Robles, California

11358 Discontinued

11403 Best Products Co.
Chicago, Illinois

11503 Keystone Mfg.
Div. of Avis Industrial Corp.
Warren, Michigan

11726 Quality ne Corp.
Santa Clara, California

12014 Chicago Rivet & Machine Co.
Bellwood, Illinois

12040 National Semiconductor Corp.
Danburry, Connecticut

12060 Diodes, Inc.
Chatsworth, California

12136 Philadelphia Handle Co.
Camden, New Jersey

12323 Presin Co., Inc.
Shelton, Connecticut

12327 Freeway Washer & Stamping Co.
Cleveland, Ohio

12400 Replaced by 75042

12617 Hamlin Inc.
Lake Mills, Wisconsin

12697 Clarostat Mfg. Co.
Dover, New Hampshire

12749 James Electronics
Chicago, Illinois

12856 Micrometals
Sierra Madre, California

12954 Dickson Electronics Corp.
Scottsdale, Arizona

12969 Unitrode Corp.
Watertown, Massachusetts

13103 Thermalloy Co.
Dallas, Texas

13511 Amphenol Corp.
Los Gatos, California

13606 Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839 Replaced by 23732

14099 Semtech Corp.
Newbury Park, California

14193 California Resistor Corp.
Santa Monica, California

14298 American Components, Inc.
Conshohocken, Pennsylvania

14655 Cornell-Dubilier Electronics
Newark, New Jersey

14674 Discontinued, see 16299

14752 Electro Cube Inc.
San Gabriel, California

14869 Replaced by 96853

15636 Elec-Trol Inc.
Northridge, California

15801 Fenwal Electronics Inc.
Framingham, Massachusetts

15818 Amelco Semiconductor
Div. of Teledyne Inc.
Mountain View, California

15849 USLCO, Inc.
Mt. Vernon, New York

15898 International Business
Machines (IBM)
Essex Junction, Vermont

15909 Replaced by 17870

16299 Corning Glass
Raleigh, North Carolina

16332 Replaced by 28478

16473 Cambridge Scientific Ind, Inc.
Cambridge, Maryland

16742 Paramount Plastics
Downey, California

16758 Delco Radio
Div. of General Motors
Kokomo, Indiana

17001 ITT Cannon
Santa Ana, California

17069 Circuit Structures Lab.
Upland, California

17856 Siliconix, Inc.
Sunnyvale, California

17870 Daven-Div of Thomas A. Edison
Ind. – McGraw - Edison Co.
Manchester, New Hampshire

18083 Deleted

18178 Vactec Inc.
Maryland Heights, Missouri

18612 Vishay Intertechnology
Inc.
Malvern, Pennsylvania

18736 Voltronics Corp.
Hanover, New Jersey

19429 Discontinued, use 89536

19451 Perine Machinery & Supply Co.
Seattle, Washington

19701 Electra Mfg. Co.
Independence, Kansas

20584 Enochs Mfg. Co.
Indianapolis, Indiana

20891 Self-Organizing Systems,
Inc.
Dallas, Texas

22767 ITT Semiconductors
Div. of ITT
Palo Alto, California

23050 Product Comp. Corp.
Mount Vernon, New York

23732 Tracor
Rockville, Maryland

23880 Stanford Applied Engrng.
Santa Clara, California

23936 Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248 Southco
Div. of South Chester Corp.
Lester, Pennsylvania

24655 General Radio Co.
West Concord, Massachusetts

24759 Lenox-Fugle Electronics
Plainfield, New Jersey

25403 Amperex Electronic Corp.
Semiconductor & Receiving
Tube Division
Slatersville, Rhode Island

27014 National
Semiconductor
Corp.
Santa Clara, California

27264 Molex Products
Downers Grove, Illinois

28425 Bohannon Industries
Fort Worth, Texas

28478 Deltrol Controls,
Corp.
Milwaukee, Wisconsin

28480 Hewlett Packard
Co.
Palo Alto, California

28520 Heyman Mfg. Co.
Kenilworth, New Jersey

29083 Monsanto, Co., Inc.
Santa Clara, California

30323 Illinois Tool
Works, Inc.
Chicago, Illinois

32539 Mura Corp.
Great Neck, New York

32767 Griffith Plastic
Products Co.
Burlingame, California

32879 Advanced Mechanical
Components
Northridge, California

32897 Erie Technological
Products, Incorporated
Frequency Control Div.
Carlisle, Pennsylvania

33173 General Electric
Co., Tube Dept.
Owensboro, Kentucky

34333 Silicon General
Westminster, California

34335 Advanced Micro
Devices.
Sunnyvale, California

37942 Mallory, P. R. & Co., Inc.
Indianapolis, Indiana

42498 National Company
Melrose, Massachusetts

43543 Nytronics Inc.
Transformer Co. Div.
Alpha, New Jersey

44655 Ohmite Mfg. Co.
Skokie, Illinois

49671 Radio Corp. of America
New York, New York

49956 Raytheon Company
Lexington, Maine

53021 Sanamo Electric Co.
Springfield, Illinois

55026 Simpson Electric Company
Chicago, Illinois

56289 Sprague Electric Co.
North Adams, Massachusetts

58474 Superior Electric Co.
Bristol, Connecticut

60399 Torrington Mfg. Co.
Torrington, Connecticut

62460 Deleted

63743 Ward Leonard Electric Co.
Mount Vernon, New York

64834 West Mfg. Co.
San Francisco, California

65092 Weston Instruments Inc.
Newark, New Jersey

66150 Winslow Tele-Tronics Inc.
Asbury Park, New Jersey

70563 Amperite Company
Union City, New Jersey

70903 Belden Mfg. Co.
Chicago, Illinois

71002 Birnbach Radio Co., Inc.
New York, New York

71236 "ELMENCO"
Willimantic, Connecticut

71400 Bussmann Mfg.
Div. of McGraw - Edison Co.
Saint Louis, Missouri

71450 CTS Corp.
Elkhart, Indiana

71468 ITT Cannon Electric Inc.
Los Angeles, California

71482 Clare, C. P. & Co.
Chicago, Illinois

71590 Centralab
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707 Coto Coil Co., Inc.
Providence, Rhode Island

71744 Chicago Miniature Lamp Works
Chicago, Illinois

71785 Cinch Mfg. Co. & Howard
B. Jones Div.
Chicago, Illinois

72005 Driver, Wilber B., Co.
Newark, New Jersey

72092 Replaced by 06980

72136 Electro Motive Mfg. Co.
Willimantic, Connecticut

72259 Nytronics Inc.
Berkeley Heights, New Jersey

72354 Deleted

72619 Dialight Corp.
Brooklyn, New York

72653 G. C. Electronics
Rockford, Illinois

72665 Replaced by 90303

72794 Dzus Fastener Co., Inc.
West Islip, New York

72928 Gudeman Co. (Gulton
Industries)
Chicago, Illinois

72982 Erie Tech. Products Inc.
Erie, Pennsylvania

73138 Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293 Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445 Amperex Electronic Corp.
Hicksville, New York

73559 Carling Electric Inc.
Hartford, Connecticut

73586 Circle F Industries
Trenton, New Jersey

73734 Federal Screw Products, Inc.
Chicago, Illinois

73743	Fischer Special Mfg. Co. Cincinnati, Ohio
73899	JFD Electronics Co. Brooklyn, New York
73949	Guardian Electric Mfg. Co Chicago, Illinois
74199	Quam Nichols Co. Chicago, Illinois
74217	Radio Switch Corp. Marlboro, New Jersey
74276	Signalite Inc. Neptune, New Jersey
74306	Piezo Crystal Co. Carlisle, Pennsylvania
74542	Hoyt Elect. Instr. Works Penacook, New Hampshire
74970	Johnson, E. F., Co. Waseca, Minnesota
75042	IRC Inc. (Div. of TRW) Philadelphia, Pennsylvania
75376	Kurz-Kasch, Inc. Dayton, Ohio
75382	Kulka Electric Corp. Mount Vernon, New York
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
77342	Potter & Brumfield Div. of Amer. Machine & Foundry Princeton, Indiana
77969	Rubbercraft Corp. of Calif. LTD. Torrance, California
78189	Shakeproof Div. of Illinois Tool Works Elgin, Illinois
78277	Sigma Instruments, Inc. South Braintree, Massachusetts
78488	Stackpole Carbon Co. Saint Marys, Pennsylvania
78553	Tinnerman Products Cleveland, Ohio
79136	Waldes Kohinoor Inc. Long Island City, New York
79497	Western Rubber Company Goshen, Indiana
79963	Zierick Mfg. Corp. New Rochelle, New York
80031	Mepco Div. of Sessions Clock Co. Morristown, New Jersey
80145	API Instruments Co. Chesterland, Ohio
80183	Sprague Products North Adams, Massachusetts
80294	Bourns Inc. Riverside, California
80583	Hammarlund Co., Inc. Mars Hill, North Carolina
80640	Stevens, Arnold Inc. Boston, Massachusetts
81073	Grayhill Inc. La Grange, Illinois
81590	Korry Mfg. Co. Seattle, Washington
81312	Winchester Electronics Div. of Litton Industries Oakville, Connecticut
81439	Therm-O-Disc Inc. Mansfield, Ohio
81483	International Rectifier Corp. Los Angeles, California
81741	Chicago Lock Corp. Chicago, Illinois
82305	Palmer Electronics South Gate, California 90280
82389	Switchcraft Inc. Chicago, Illinois
82415	Price Electric Corp. Frederick, Maryland
82872	Roanwell Corp. New York, New York
82877	Rotron Mfg. Co., Inc. Woodstock, New York
82879	ITT Wire & Cable Div. Pawtucket, Rhode Island
83003	Varo Inc. Garland, Texas
83298	Bendix Corp. Electric Power Division Eatontown, New Jersey
83330	Smith, Herman H., Inc. Brooklyn, New York
83478	Rubbercraft Corp. of America New Haven, Connecticut
83594	Burroughs Corp. Electronic Components Div. Plainfield, New Jersey
83740	Union Carbide Corp. Consumer Products Div. New York, New York
84171	Arco Electronics, Inc. Great Neck, New York
84411	TRW Ogallala, Nebraska
86577	Precision Metal Products Stoneham, Massachusetts
86684	Radio Corp. of America Electronic Components & Devices Harrison, New Jersey
86689	Deleted
87034	Marco-Oak Inc. Anaheim, California
88245	Litton Products Inc. Van Nuys, California
88419	Use 14655
88690	Replaced by 04217
89536	Fluke, John Mfg. Co., Inc. Seattle, Washington
89730	Replaced by 08806
90201	Mallory Capacitor Co. Indianapolis, Indiana
90215	Best Stamp & Mfg. Co Kansas City, Missouri
90211	Square D Co. Chicago, Illinois
90303	Mallory Battery Co. Tarrytown, New York
91293	Johanson Mfg. Co. Boonton, New Jersey
91407	Replaced by 58474
91502	Associated Machine Santa Clara, California
91506	Augat Attleboro, Mass.
91637	Dale Electronics Inc. Columbus, Nebraska
91662	Elco Corp. Willow Grove, Pennsylvania
91737	Gremar Mfg Co., Inc. (ITT) Woburn, Massachusetts
91802	Industrial Devices, Inc. Edgewater, New Jersey
91836	King's Electronics Tuckahoe, New York
91929	Honeywell Inc. Micro Switch Div. Freeport, Illinois
91934	Miller Electric Co., Inc. Pawtucket, Rhode Island
93332	Sylvania Electric Products Semiconductor Products Div Woburn, Massachusetts
94145	Replaced by 49956
94154	Tung-Sol Div. of Wagner Electric Corp. Newark, New Jersey
95146	Alco Electronics Products Inc. Lawrence, Massachusetts
95263	Leecraft Mfg. Co. Long Island City, New York
95264	Replaced by 98278
95275	Vitramon Inc. Bridgeport, Connecticut
95303	Radio Corp. of America Solid State & Receiving Tube Div. Cincinnati, Ohio
95354	Methode Mfg. Corp. Rolling Meadows, Illinois
95712	Dage Electric Co., Inc. Franklin, Indiana
95987	Weckesser Co. Inc. Chicago, Illinois
96733	San Fernando Electric Mfg. Co. San Fernando, California
96853	Rustrak Instrument Co. Manchester, New Hampshire
96881	Thomson Industries, Inc. Manhasset, New York
97540	Master Mobile Mounts Div. of Whitehall Electronics Corp. Los Angeles, California
97913	Industrial Electronic Hdware Corp. New York, New York
97945	White, S. S. Co. Plastics Div. New York, New York
97966	Replaced by 11358
98094	Replaced by 49956
98159	Rubber-Teck, Inc. Gardena, California
98278	Microdot Inc. Pasadena, California
98291	Sealectro Corp. Conhex Div. Mamaroneck, New York
98388	Accurate Rubber & Plastics Culver City, California
98743	Replaced by 12749
98925	Deleted
99120	Plastic Capacitors, Inc. Chicago, Illinois
99217	Southern Electronics Corp. Burbank, California
99392	STM Oakland, California
99515	Marshall Industries Capacitor Div. Monrovia, California
99779	Barnes Corp. Lansdowne, Pennsylvania Toyo Electronics (R-Ohm Corp.) Irvine, California 92664 National Connector Minneapolis, Minn. 55436

Appendix C

Sales Representatives

ALABAMA

HUNTSVILLE
BCS Associates, Inc.
3322 S. Memorial Parkway
P.O. Box 1273
Tel. (205) 881-6220
Zip 35801

ALASKA

SEATTLE
Showalter-Judd, Inc.
5616 4th Ave. South
Tel. (206) 762-2310
Zip 98108

ARIZONA

PHOENIX
Barnhill Associates
7329 E. Stetson Dr.
Tel. (602) 947-7841
Scottsdale, AZ 85251

CALIFORNIA

LOS ANGELES
Instrument Specialists, Inc.
1109 S. Central Ave.
Glendale, California 91204
Tel. (213) 245-9404

SANTA CLARA
Instrument Specialists, Inc.
2359 De La Cruz Blvd.
Tel. (408) 244-1505
Zip 95050

SAN DIEGO
Instrument Specialists, Inc.
4805 Mercury St., Ste. 1
Tel. (714) 565-2555
Zip 92111

COLORADO

DENVER
Barnhill Associates
1170 S. Sheridan Blvd.
Tel. (303) 934-5505
Zip 80226

CONNECTICUT

HARTFORD
Instrument Representatives, Inc.
P.O. Box 165
Glastonbury, Connecticut 06033
Tel. (203) 633-0777

FLORIDA

ORLANDO
BCS Associates, Inc.
940 N. Fern Creek Ave.
Tel. (305) 896-4881
Zip 32803

HAWAII

HONOLULU
Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 533-6095
Zip 96817

ILLINOIS

CHICAGO
Cozzens & Cudahy, Inc.
1301 N. Rand Rd.
Des Plaines, IL 60016
Tel. (312) 298-3600

INDIANA

INDIANAPOLIS
Cozzens & Cudahy, Inc.
Port O'Call Executive Ctr.
21 Beachway Drive
Tel. (317) 244-2456
Zip 46224

MARYLAND

BALTIMORE
Electronic Marketing Assoc. Inc.
11501 Huff Court
Kensington, Maryland 20795
Tel. (301) 881-5300, 744-7700

MASSACHUSETTS

BOSTON
Instrument Representatives, Inc.
109 Massachusetts Ave.
Lexington, MA 02173
Tel. (617) 861-8620

MICHIGAN

DETROIT
WKM Associates, Inc.
1474 East Outer Dr.
Tel. (313) 892-2500
Zip 48234

MINNESOTA

MINNEAPOLIS
Cozzens & Cudahy, Inc.
10800 Lyndale Ave. S.
Tel. (612) 884-4336
Zip 55420

MISSOURI

ST. LOUIS
Cozzens & Cudahy, Inc.
P.O. Box 10013
Lambert Field - Zip 63145
Tel. (314) 423-1234

NEW JERSEY

NEWARK
SBM Representatives
1519 Stuyvesant Avenue
Union, New Jersey 07083
Tel. (201) 687-8737

NEW MEXICO

ALBUQUERQUE
Barnhill Associates
1410 — D Wyoming N.E.
Tel. (505) 299-7658
Zip 87112

NEW YORK

NEW YORK
SBM Representatives
28 Hobby Street
Pleasantville, N.Y. 10570
Tel. (914) 769-1811

ROCHESTER
SBM Representatives
4515 Culver Rd.
Tel. (716) 226-1400
Zip 14622

NORTH CAROLINA

GREENSBORO
P.O. Box 9619
1310 Beahan Pl.
Tel. (919) 273-1918
Zip 27408

OHIO

CLEVELAND
WKM Associates, Inc.
16141 Puritas Ave.
Tel. (216) 267-0445
Zip 44135

DAYTON
WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45459

PENNSYLVANIA

PHILADELPHIA
Electronic Marketing Assoc.
210 Goddard Blvd., Ste. 100
King of Prussia, Pennsylvania
Tel. (215) 248-5050
Zip 19406

PITTSBURGH
WKM Associates, Inc.
90 Clairton Blvd.
Tel. (412) 892-2953
Zip 15236

TEXAS

DALLAS
Barnhill Associates
Suite 220
312 N. Central Express Wy.
Richardson, Texas 75080
Tel. (214) 231-2573

HOUSTON
Barnhill Associates
Suite 332
3810 Westheimer
Tel. (713) 621-0040
Zip 77027

WASHINGTON

SEATTLE
Showalter-Judd, Inc.
5616 4th Ave. South
Tel. (206) 762-2310
Zip 98108

CANADA

BRITISH COLUMBIA

VANCOUVER
Allan Crawford Associates, Ltd.
1820 Pandora St.
Tel. (604) 253-7136

ALBERTA

CALGARY
Allan Crawford Associates, Ltd.
640 - 11th Ave. S.W.
Tel. (403) 261-0780

ONTARIO

MALTON
Allan Crawford Associates, Ltd.
6427 Northam Drive
Tel. (416) 678-1500

OTTAWA, 3
Allan Crawford Associates, Ltd.
376 Churchill Ave., Suite 106
Tel. (613) 829-9651

QUEBEC

LONGUEUIL
Allan Crawford Associates, Ltd.
157 (rue) St. Charles Street W.
Tel. (514) 670-1212

INTERNATIONAL REPRESENTATIVES

ARGENTINA
Coasin S.A.
Virrey del Pino 4071
Buenos Aires, Argentina

AUSTRALIA
Elmeasco Instruments
P.O. Box 334
Brookvale, N.S.W. Australia 2100

AUSTRIA
Kontron GMBH & Co., Kg.
Lederergasse 16
1080 Vienna, Austria

BELGIUM
C.N. Rood S.A.
37 Place de Jamblinne de Meux
1040 Brussels, Belgium

BRAZIL
Ambriex S.A.
Rue Ceara, 104 - 2.º e 3.º Andares
ZC - 29
Rio de Janeiro GB, Brazil

Ambriex S.A.
Rua Tupi, 535
01233 Sao Paulo SP, Brazil

CARIBBEAN
West Indies Sales Co.
606 Calle Aboy
San Juan, Puerto Rico 00907

CHILE
Coasin Chile Ltd.
Casilla 14588 - Correo 15
Santiago, Chile

CHINA, Peoples Republic Of
May Lee Industries, Inc.
475 Park Avenue South
New York, N.Y. 10016

COLOMBIA
Marones Ltda.
Apartado Aereo 90687
Bogota 8, Colombia

DENMARK
Tage Olsen A/S
1, Rønnegade
Copenhagen Ø, Denmark

ECUADOR
Proteco Coasin Cia., Ltda.
Apartado 228A
Quito, Ecuador

FINLAND
Oy Findip AB
P.O. Box 25
00521 Helsinki 52, Finland

FRANCE
M.B. Electroniques S.A.
29, Rue Emile Duclaux
92, Suresnes
France

GERMANY
Fey Elektronische Messgerate
8 Muenchen 19
Horemansstrasse 28
West Germany

GREECE
Marios Dalleggio Representations
2 Alopekis Street
Athens 19 Greece

HONG KONG & MACAU
Gilman & Co., Ltd.
P.O. Box 56
Hong Kong

INDIA
Hinditron Services Pvt. Ltd.
69/A Nepean Sea Road
Bombay-6 India

IRAN
Berkeh Company Ltd.
20 Salm Road, Roosevelt Ave.
Tehran, Iran

ISRAEL
R.D.T. Electronics Engineering Ltd.
19 Prof. Shor Street
Tel-Aviv, Israel

ITALY
Sistrel S.P.A.
Via Giorgio da Sebenico 11-13
Rome, Italy

JAPAN
Toyo Trading Co. Ltd.
P.O. Box 5014
Tokyo International
Tokyo 100-31, Japan

Suzuki Bldg.
2-38 Junkeicho-dori
Minami-ku, Osaka

KOREA
Asia Science & Co.
Internaltion P.O. Box 1250
Seoul, Korea

MALAYSIA
O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu
East Malaysia

P.O. Box 91
Petaling Jaya, Selangor
West Malaysia

MEXICO
Mexitek, S.A.
Eugenia 408
Departments 1 y 5
Mexico 12, D.F.
Mexico

THE NETHERLANDS
C.N. Rood B.V.
13 - Cort van der Lindenstraat
Rijswijk (Z.H.) 2100
Netherlands

Fluke (Nederland) B.V.
Ledeboerstraat 27
Industrieterrein Noord
Tilburg, Netherlands

NEW ZEALAND
David J. Reid (N.Z.) Ltd.
C.P.O Box 2630
Auckland 1, New Zealand

NIGERIA
Deemtee Electrotechnics Ltd.
P.O. Box 3073
Lagos, Nigeria

NORWAY
Morgenstierne & Co. A/S
P.O. Box 6688 Rodeløkka
Oslo 5, Norway

PAKISTAN
Pak International Operations
505 Muhammadi House-McLeod Rd.
P.O. Box 5323
Karachi, Pakistan

PERU
Importaciones y Representaciones Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru

PORTUGAL
Equipamentos De Laboratorio, Lda.
P.O. Box 1100
Lisbon, Portugal

SINGAPORE
O'Connor's (Pte) Ltd.
98 Pasir Panjang Road
Singapore 5, Singapore

SOUTH AFRICA
K. Baker Associates (Pty) Ltd.
P.O. Box 1257
Johannesburg
Republic of South Africa

P.O. Box 3641
Cape Town

SPAIN
Atalo Ingenieros S.A.
Enrique-Larretta 12
Madrid 16, Spain

SWEDEN
Teleinstrument AB
P.O. Box 490
S-16204 Vallingby
Sweden

SWITZERLAND
Kontron Electronic A.G.
Bernerstrasse Sud 169
8048 Zurich
Switzerland

TAIWAN-REPUBLIC OF CHINA
Heighten Trading Company, Ltd.
P.O. Box 1408
Taipei, Taiwan 104

THAILAND
G. Simon Radio Ltd.
30 Patpong Avenue
Suriwong
Bangkok, Thailand

THE UNITED KINGDOM
Fluke International Corp.
Garnett Close
Watford, WD2 4TT
England

URUGUAY
Coasin Uruguay S.A.
Cerrito 617 - 4º Piso
Montevideo, Uruguay

U.S.S.R.
Codevintec Pacific Inc.
6263 Variel
Woodland Hills, Calif. 91364

VENEZUELA
Coasin C.A.
Apdo. Postal 50939
Sabana Grande No.1
Caracas 105
Venezuela

In Europe, contact FLUKE NEDERLAND, B.V., POST OFFICE BOX 5053, INDUSTRIETERREIN NOORD, TILBURG, THE NETHERLANDS

FLUKE REGIONAL SERVICE CENTER; THE NETHERLANDS

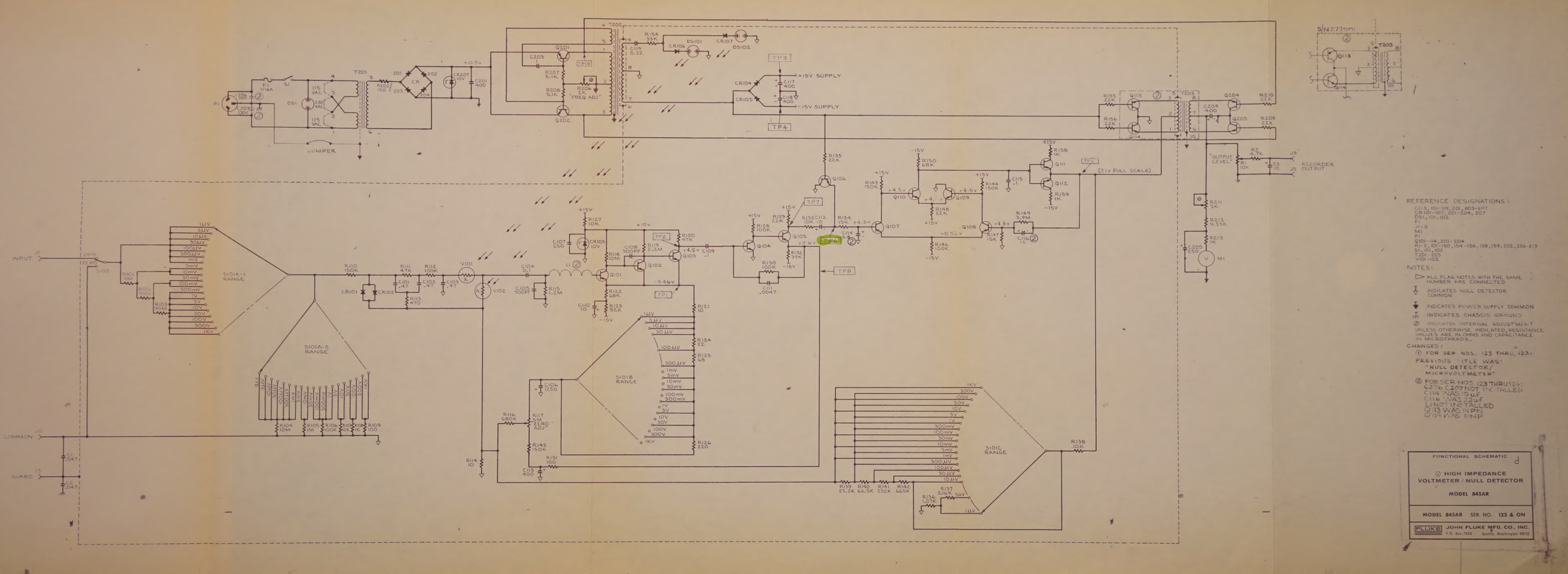
FLUKE (NEDERLAND) B.V.
P.O. BOX 5053
TILBURG, THE NETHERLANDS

FLUKE REGIONAL SERVICE CENTER, UNITED KINGDOM

FLUKE INTERNATIONAL CORP.
GARNETT CLOSE
WATFORD, WD24TT
ENGLAND

AUTHORIZED SERVICE LABORATORIES INTERNATIONAL

EACH INTERNATIONAL REPRESENTATIVE IS EQUIPPED WITH AN AUTHORIZED SERVICE LABORATORY. PLEASE REFER TO THE INTERNATIONAL REPRESENTATIVE LISTING FOR YOUR SERVICE NEEDS.



REFERENCE DESIGNATIONS:

C1-3, 101-119, 201-203-207
CR101-107, 201-204, 207
DS1, 101, 102
F1
J1-5
M1
P1
Q101-114, 201-204
R1-2, 101-150, 154-156, 158, 159, 202, 206-213
S1, 101, 102
T201-203
V101-102

NOTES:

- ▷ ALL FLAG NOTES WITH THE SAME NUMBER ARE CONNECTED
- ⏚ INDICATES NULL DETECTOR COMMON
- ⏚ INDICATES POWER SUPPLY COMMON
- ⏚ INDICATES CHASSIS GROUND
- ② INDICATES INTERNAL ADJUSTMENT

UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS AND CAPACITANCE IN MICROFARADS.

CHANGES:

① FOR SER NOS. 123 THRU 133:
PREVIOUS TITLE WAS "NULL DETECTOR/ MICROVOLTMETER"

② FOR SER NOS. 123 THRU 129:
C206, C207 NOT INSTALLED
C114 WAS 10 µF
C116 WAS 22 µF
L1 NOT INSTALLED
Q13 WAS NPN
Q14 WAS PNP

FUNCTIONAL SCHEMATIC ①

HIGH IMPEDANCE VOLTMETER / NULL DETECTOR

MODEL 845AR

MODEL 845AR SER. NO. 123 & ON

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

www.manualsplus.com
1036280